CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

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Sustainable solutions for people and societies

Full Proposal 2017-2022

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LED BY: IWMI International Water Management Institute

IN PARTNERSHIP WITH: Bioversity International, CIAT, CIFOR, CIP, FAO, ICARDA, ICRISAT, IFPRI International Food Policy Research Institute, ILRI International Livestock Research Institute, World Agroforestry Centre, WorldFish

Annexes are available in the second volume (WLE Phase 2 – Annexes).

1.0 CRP Narrative[1]

1.0.1 Rationale and scope

WLE's vision is for a world in which agriculture thrives within the vibrant ecosystems that support it while delivering enduring prosperity for farming communities.

Rationale for a global research program on water, land and ecosystems

Global agriculture is one of humanity's great success stories because we produce more food than ever before. But this success masks two uncomfortable truths. First, while responding to the rising demand for food, agricultural growth is depleting the natural resource base on which it depends. There is growing evidence that the impressive gains in yields in recent decades are beginning to plateau, and may not keep pace with future demand. In some regions, available water or soil fertility limitations have already been reached. Intensification of agriculture through unsustainable practices is eroding the natural resource base and over-stretching ecosystem services, especially in areas where capacity to enforce controls is constrained. Fortunately, there is also evidence that it is possible to combine sustainable intensification of agriculture with conserving natural capital under the right conditions (Hazell and Wood 2008; Pretty 2008; Pretty and Bharucha 2014).

Second, there is a growing consensus that the Earth has entered an era in which human activity is a dominant factor affecting global climate and hydrological and biosphere systems (e.g. IPCC 2014). One formulation posits the existence of nine planetary boundaries characterizing the Earth's biophysical processes. Of these, three have already been crossed (climate change, biodiversity loss, and nitrogen cycle) and others are approaching the hypothesized boundaries, including the phosphorous cycle, land use, and freshwater use (Rockström et al. 2009, 2014)[2]. Agriculture is a major contributor to these anthropogenic trends. The combination of climate change, over-exploitation of water, degradation of soils, and loss of biodiversity are serious threats to food security and our future survival.

Producing enough food for a growing, urbanizing and wealthier human population will be especially challenging, as food production is by far the largest user of water, occupies large land areas, and is putting more pressure on already degraded ecosystems. Schewe et al. (2014) identified additional pressures coming from climate change: although there is a significant degree of uncertainty, their study shows that climate change is likely to severely exacerbate national and regional water scarcity, possibly increasing the number of people living under water scarcity (<500 m^3 per capita per year) by 40%. Water "scarcity" is further worsened in many contexts by increasingly variable and unpredictable rainfall. This could well lead to rising socioeconomic inequality as well – a potentially critical vicious cycle (Ringler et al. 2016; Altchenko and Villholth 2015). This also argues for staying within a safe social operating space of the Earth Systems as argued by Leach et al. (2013) and Raworth (2012).

Further amplifying these challenges, 20-25% of the global land area is estimated to be severely degraded, of which some 100 million hectares (Mha) is attributed to erosion, deforestation and land-use changes, excessive fertilizer use, waterlogging, salinization, acidification and nutrient extraction (ELD Initiative 2015). Land degradation impacts the health and livelihoods of 1.5 billion people (FAO 2011), often disproportionally affecting children, women and the poor; 65% of the agricultural land in

[1] All references are listed in Annex 3.15.

[2] See Steffen et al. (2015) for an updated discussion on the Planetary Boundaries concept, and Leach et al. (2013) on the social safe operating space within the planetary boundaries.

sub-Saharan Africa is classified as degraded (Vlek et al. 2008), costing USD 68 billion per year, and reducing the agricultural gross domestic product (GDP) by 3% (Zingore et al. 2015). Land-use changes and degradation, droughts and floods, over-pumping of aquifers, and water pollution, in turn, pose existential threats to biodiversity: loss of agricultural biodiversity poses long-term risks to agricultural systems, and along with degradation of soils and water, seriously compromises ecosystem services and reduces the resilience of food systems and livelihoods (e.g. Balvanera et al. 2016), and increases inequality (Narayan et al. 2013).

These negative trends in the quality and availability of natural resources pose serious threats to our ability to achieve the new United Nations Sustainable Development Goals (SDGs) as well as the goals of the CGIAR Strategy and Results Framework (SRF[3]). However, it does not have to be this way. The evidence is mounting that, if societies approach agriculture differently, all the food needed can be grown at a reasonable cost, without degrading natural systems. Sustainability is a prerequisite for intensification of agriculture (Leach et al. 2013; IPES-Food 2015; Steffen et al. 2015). Sustainable intensification is a key strategy to develop more resilient agricultural systems (Pretty and Bharucha 2014). Directly linked to this is the notion that greater social equality, including gender equality, and mobilizing youth, are essential to achieve long-term sustainable and productive management of natural resources (e.g. Narayan et al. 2013).

Resilience defines a system's capacity to withstand shocks and stresses, transform in response to changing conditions, and adapt in crisis situations. Farming systems where ecosystems and agricultural landscapes are managed in sustainable ways, i.e. sustain biodiversity and soil productivity, and safeguard freshwater resources, will be more resilient to shocks and changing conditions, and more productive in the longterm.

Additionally, cities are increasingly important drivers of future food demands, are major water and energy users, and are growing sources of water and land degradation. There is a critical need to assess resource flows between rural and urban areas, and identify opportunities to sustainably recycle urban wastes while ensuring food and water supplies to city dwellers, especially the poor.

Agriculture is thus both the major driver of natural resource risks and degradation, and also the key to reversing these trends. With 70% of global freshwater resources used for food production, agriculture has a special responsibility to help avert a potential 'water crisis,' which globally remains among the top three risks to economic growth (WEF 2015).These two interactive aspects — 1) sustainable agriculture as an avenue for development within a safe planetary operating space, which in turn safeguards multi-functional ecosystems; and 2) sustainable and equitable agriculture for building resilience from farm to landscape and securing productive food systems — are at the heart of the CGIAR Research Program on Water, Land and Ecosystems (WLE).

WLE's mission is to provide the evidence base and solutions to help decision makers scale up sustainable water, land and ecosystem management innovations and investments in agricultural landscapes that reduce risks and increase the resilience of women and men in developing countries. It achieves this through a focus on increasing productivity and identifying synergies and managing trade-offs among sectors. WLE supports implementation of multiple Sustainable Development Goals (SDGs).

The new landscape of the CGIAR Research Programs (CRPs) takes an integrated approach to agricultural research and development. Several CRPs focus on the major food crop systems, while others focus on livestock, fish and tree-based systems. Crosscutting or integrating CRPs (ICRPs)

[3] Definitions of acronyms and abbreviations are given in Annex 3.14.

address climate change (CCAFS), policies and institutions (PIM), and natural resources (WLE). Further, all CRPs, including WLE, take the critical importance of social and economic equality seriously, especially with regard to gender. WLE has positioned itself to collaborate with AFS CRPs and ICRPs to address high-priority challenges whose solutions will enable CGIAR to achieve its targets and will support achievement of the SDGs.

Scope of WLE's research-for-development agenda

"Water, land and ecosystems" potentially includes an extremely broad domain. Therefore, WLE has focused on a subset of globally critical challenges. WLE has used the following criteria to achieve this focus: 1) issues that are critical to achieving the SDGs and CGIAR targets, including addressing the CGIAR "Grand Challenges"; 2) work that will add value to, and have clear synergies with, other CRPs; 3) issues where WLE can build on previous accomplishments and has a strong comparative advantage; 4) issues where there is significant potential to contribute to social and economic equality, especially by benefiting women as well as men, and providing attractive opportunities for young people in agriculture and provision of ecosystem services; and 5) other emerging critical natural resources management (NRM) issues that are not being addressed.

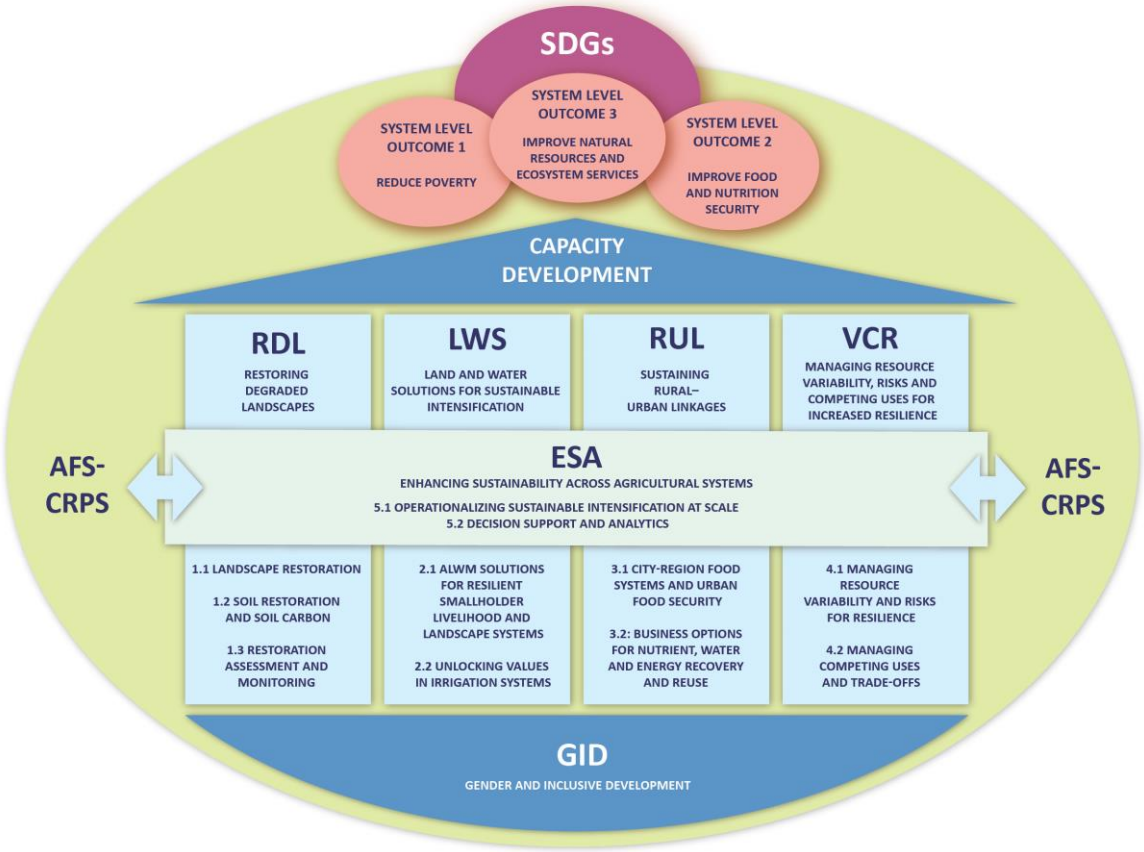


Figure 1.1 WLE's Overall Structure with 5 Flagships (RDL, LWS, RUL, VCR, ESA) and the Gender Core Theme (GID)

Applying these criteria, WLE will address the following critical challenges during the next phase, through four thematic and one integrating flagships, as shown in *Figure 1.1*, focusing on identifying, testing and scaling out innovative and practical solutions:

1 The rapid degradation of soils, water and biodiversity in agricultural landscapes seriously compromises ecosystem services, and reduces the sustainability and resilience of food systems and livelihoods. WLE will support governments and people to restore their degraded landscapes

to enhance ecosystem services, thereby contributing to vibrant agroecosystems and the benefits they provide: food, energy, clean water and others. This work responds directly to a growing political momentum for large-scale commitments to prevent degradation and to restore or regenerate degraded natural resources and ecosystem services. (*WLE Flagship on Restoring Degraded Landscapes [**RDL**]*)

2 Agriculture is the largest user of land and water resources, providing employment for over one billion people, about 30-40% of the labor force, including the highest proportion of female and child labor in developing economies (ILO 2011). Agriculture will continue to be a major source of employment for decades, making it imperative to find ways to provide attractive, non-exploitative opportunities for young women and men. Agriculture must also adapt to rapid demographic changes, and the impacts of expanding urban and industrial areas and climate change. Therefore, WLE will focus on improving the understanding of the complex and dynamic biophysical, socioeconomic, and institutional factors, including social equality, which influence productivity of water and land resources under agricultural intensification. Based on this understanding, WLE will develop and apply solutions for managing the natural resource base (agricultural land and water, including irrigated agro-ecosystems) and sustaining ecosystem services at landscape scale. This work will help to improve the management of agro-ecological landscapes, reverse low productivity, and enable sustainable food security. This will be essential for sustainable intensification of agriculture and will bring substantial benefits to women as well as men. *(WLE Flagship on Land and Water Solutions for Sustainable Intensification **[LWS**]*)

3 Urbanization is the pre-eminent global phenomenon of our time, with significant implications for food security. It can be an opportunity for new markets and business models to foster well-being and economic growth, thereby offering rural farmers new income-generating options. However, it also comes with significant risks and challenges affecting water, land and ecosystems. The environmental footprint of rapidly growing urban consumption centers in many low- and middle-income countries is threatening the delivery of ecosystem services on which cities, their watersheds and urban food security depend. WLE will focus on the means to reduce the growing environmental footprint of urbanization by identifying, testing and promoting practical solutions involving recovery and reuse of water, nutrients and energy currently lost through poor urban waste management. This work will focus on rural-urban linkages and contribute to moving toward a more sustainable **circular economy** (Ellen MacArthur Foundation 2015). (*WLE Flagship on Rural and Urban Linkages [**RUL**]*)

4 Water-related disasters affect millions of people and cause billions of dollars of damage annually, and they are getting more frequent. WLE will build on earlier work to reduce the risks caused by growing variability in water supply leading to reduced water security, while also finding ways to reduce competition for scarce water supplies and increase resource-use efficiency across the agriculture-water-energy-food nexus. There is a growing understanding that while draining aquifers in several “breadbasket” regions is an existential threat to irrigated agriculture, more sustainable use of groundwater offers huge opportunities as well. Therefore, WLE will develop and roll out a new research initiative, **Groundwater Solutions Initiative for Policy and Practice (GRIPP).** (*WLE Flagship on Managing Resource Variability, Risks and Competing Uses for Increased Resilience [**VCR**]*).

The full flagship proposals describe how these four challenges have been broken down into specific research questions, accompanied by proposed impact pathways, to be implemented in collaboration with many partners. These challenges do not exist in isolation and cannot be effectively addressed without significant collaboration among the WLE flagships, with AFS CRPs and ICRPs, and with external

partners, working together in specific CGIAR collaboration countries and regions. The fifth WLE Flagship, *Enhancing Sustainability across Agricultural Systems* (**ESA**), is designed to work at larger scales, complementing and facilitating our partnerships. This Flagship will help catalyze the transformations needed in smallholder agriculture to achieve sustainable and equitable intensification by integrating research findings from CRPs, CGIAR centers and other partners to support real-life development decisions and investments across commodities, sectors and scales. ESA will refine, test and benchmark sustainability indicators at scale, utilizing elements of the Ecosystem Service and Resilience (ESR) framework from Phase 1 and other relevant frameworks. The new approach can be used to monitor trends in diverse agro-ecosystems.

Each of the flagships will work with, and be supported by, the core theme, *Gender and Inclusive Development* (**GID**). WLE recognizes the need to strengthen the positive roles of women and youth in sustainable intensification, and to facilitate the transformations that the involvement and leadership of women and youth can have on NRM.

An important question facing the CGIAR research agenda is how much should be invested in identifying and promoting incremental innovations versus investing in identifying, testing and eventually promoting transformative changes in landscapes and ecosystems. The CCAFS (2016) proposal also raises this question, pointing to data that suggest that incremental adaption by itself may not be adequate to address the impacts of climate change in the medium to long term. Traditionally, CGIAR research, including work on water, land and ecosystems, has largely focused on identifying innovations that will enable incremental improvements in productivity, profitability, or efficiency of resource use. This will remain an important thrust for the next decade or so. However, **WLE concurs with CCAFS that it is critically important to invest in identifying game-changing innovations that will transform agro-ecosystems and the institutions through which they are managed.** WLE scientists will work with CCAFS and other CRPs, as well as partners from outside the CGIAR, to combine our science with our imaginations, looking beyond the 2022 CGIAR targets.

1.0.2 Goals, objectives and targets

The CGIAR has adopted an ambitious **Strategy and Results Framework (SRF)** that aims to help achieve a set of global goals, including the newly adopted Sustainable Development Goals (SDGs; see below), by the year 2030. Phase 2 of WLE is designed to contribute directly to achieving System-Level Outcome (SLO) 3, "improving natural resource systems and ecosystem services". WLE will also contribute significantly to achieving SLO 1, "reduced poverty", and will help the CGIAR to achieve four Intermediate Development Outcomes (IDOs): the three under SLO 3 (enhanced natural capital, enhanced benefits from ecosystem services, and sustainably managed ecosystems), and the IDO on improved resilience of the poor to climate change and other shocks under SLO 1. WLE will also contribute to achieving health and nutrition benefits (SLO 2) from better processing and reuse of waste. It is committed to doing this by engaging and harnessing the transformative power of women and youth. WLE will make major contributions to achieving five of CGIAR's ambitious targets for 2022, both directly and through synergies with other CRPs as follows:

SLO1.1: 21 million (21%) of the target of 100 million more farm households have adopted **…** improved [water and land] management practices

SLO1.2: 5.74million (19%) of the targeted 30 million people of which 50% are women, assisted to exit poverty

SLO3.1: 5% increase in water- and nutrient-use efficiency over 24.07 Mha of the 5% increase across all target countries

SLO 3.2: 0.01GT reduction in agriculture-related GHG emissions, 5% of the0.2 GT CO_2e/yr target

SLO 3.3: 7.7 Mha of degraded land restored, 14% of the 55 Mha target.

Further details on WLE's contributions to these targets by flagship and country, including proposed budget allocations, are provided in Section 1.2 below.

WLE will also help the CGIAR address at least five of the "societal grand challenges" described in the SRF: climate change, competition for land, soil degradation, overdrawn and polluted water supplies, nutritious and diverse agri-food systems and diets, and new entrepreneurs and job seekers. The CGIAR SRF proposes to achieve its targets by addressing eight global research priorities where it has a comparative advantage. WLE contributes directly to achieving five of these and less directly, but significantly, to one other (*Table 1.1*).

Table 1.1 WLE Contribution to CGIAR Global Research Priorities

Direct contribution to:	Less direct contribution to:
Natural resources and ecosystem services Climate-smart agriculture Agricultural systems Gender and inclusive growth Enabling policies and institutions	Nutrition and health

WLE with its partners has been making important contributions to the development of targets and indicators for the Sustainable Development Goals (SDGs). WLE will continue to provide direct support for the achievement of at least six Sustainable Development Goals (SDGs 1, 2, 5, 6, 13 and 15)[4], and indirectly to at least two others (SDGs 3, 7)[5]. The CRP will work largely at landscape and watershed levels, complementing the farm- and household-scale research of AFS CRPs. As described in more detail in Section 1.0.6 below and in the flagship proposals, each WLE flagship contributes to one or more priority issue related to the CGIAR targets and the SDGs. One flagship (RDL) will focus on restoring or regenerating degraded landscapes to enable people to produce more food and other ecosystem services. Another (LWS) will focus on improving the management of land and water resources at the landscape scale and on irrigation schemes, to complement on-farm interventions developed by the AFS CRPs. A third (RUL) will contribute to maximizing urban food security and minimizing the footprint of urbanization on soils, water, livelihoods and ecosystem services, thus strengthening rural-urban linkages in ways that are synergistic and mutually beneficial. A fourth flagship (VCR) will focus on reducing the risks associated with the variability, growing scarcity and degradation of natural resources, water-related disasters and competing uses of water, land, energy and other ecosystems services, and to facilitate their availability to all. The fifth, integrative flagship (ESA) facilitates WLE collaboration with partner AFS CRPs and others to identify and test ways to integrate multiple innovations to promote sustainable intensification at scale in specific regions.

SDG 5 is intended to achieve gender equality and empower women and girls. Women play critical roles in all agricultural systems, doing about half of all agricultural work in parts of Asia and Africa; with the

[4] End poverty (1), end hunger and achieve food security (2), achieve gender equality (5), availability and sustainable management of water and sanitation for all [target 6.4: improving water productivity and access] (6), combat climate change and its impacts (13), and protect, restore, promote sustainable use of terrestrial ecosystems and halt and reverse land degradation and biodiversity loss (15).
[5] Ensure healthy lives (3), ensure access to affordable … sustainable … energy (7).

expansion of male migration for employment, their burden is increasing. Further, women play important roles in water and land management, and making use of other ecosystem services. It will not be possible to achieve the CGIAR and SDG targets without achieving SDG 5 – gender equality. This will require transformations in entire socio-agro-ecological systems, including policies and institutions. It will also mean exploring the role of equality in sustainable intensification, and reducing the barriers and increasing the capabilities for women and men to be engaged. WLE, like other CRPs, has taken this on board and has integrated a strong Gender and Inclusive Development (GID) core theme into the bloodstream of its work. By 2022, WLE, working with its CGIAR and other partners, will make a significant contribution to achieving the gender target.

1.0.3 Impact pathways and theory of change

There is growing recognition that landscape approaches are essential to tackle competing demands on water and land resources. The 2015 Global Opportunity Report, based on a survey of 6,000 private sector professionals from 21 countries, lists investments in resilience, cost-effective adaptation, rural growth and water-effective agriculture among the top business opportunities. Landscape restoration approaches are seen as the most viable way to address complex problems requiring trade-off analysis across sectors and scales (Sayer et al. 2013). The World Bank, Inter-American Development Bank, African Union and GIZ are all committed to large-scale land restoration initiatives. Examples are the 20x20 Initiative in Latin America, Sustainable Land Management Program of Ethiopia and the Africa-wide 'Soil Rehabilitation for Food Security'.

Agro-ecosystems have multiple linkages and feedback loops among their social, economic and biophysical subsystems. Therefore, an intervention in one dimension can often lead to multiple, often unanticipated, impacts in others. A key challenge is to resolve inter-sectoral and scale mismatches that an exclusive focus at farm and household level will fail to address (Cumming et al. 2006, 2014). Failure to consider these multiple linkages and their consequences is also a potential threat to planetary system boundaries. Research to understand existing mismatches and their causes, and to provide potential solutions, is critically important. Past CGIAR research has demonstrated that interdisciplinary approaches embracing the complexity of agro-ecosystems can lead to positive outcomes at landscape level (e.g. Sayer et al. 2013).

Because of the inherent complexity of landscape-scale management, any Theory of Change (ToC) must be viewed as a *theory* whose validity, underlying assumptions, and means of verification are constantly reviewed. Therefore, WLE's ToC provides a conceptual framework illustrating how we expect our research to lead to desirable outcomes and impacts. However, this framework will itself be reviewed regularly and revised as needed. Our adaptive learning will be supported by our Monitoring, Evaluation and Learning (MEL) system, enabling regular, systematic assessment of progress toward planned outcomes and impacts, and adapting the program based on objective evaluation of results (as explained in Annex 3.5).

Major changes in behavior by many stakeholders at multiple scales will often be necessary to transition from current unsustainable and low-productivity practices to dynamic, sustainable, high-productivity systems. Achieving this will be a function of institutional changes: changes in values, incentives, norms, policies, organizations, and relationships among stakeholders. There is considerable inertia in any institutional system. For example, reforms aimed at enabling women to gain equal access to land and water resources often meets stiff resistance. Such institutional resistance plagues efforts to improve irrigation services, especially on large government-managed systems (Merrey et al. 2007). WLE cannot achieve such changes alone. However, we can work with our partners, including other CRPs, local organizations, national governments, regional institutions, NGOs,

and financing institutions from the planning stage to use research-based evidence to understand and establish leverage points to catalyze change.

WLE will collaborate with our uptake partners to jointly identify priority targets for focused, high-quality credible research. Results will be pilot tested for feasibility and up-scaling. Promising interventions will be packaged and communicated jointly with partners, and WLE will assist and advise on implementation. Each step requires feedback loops to monitor, evaluate, adjust and share the results and lessons. Engaging with key decision makers (change agents), we will provide practical policy and investment advice, and support capacity development where needed, to accelerate achievement of desired outcomes. Throughout this cycle, WLE will monitor the validity of the assumptions and mechanisms (impact pathways) that constitute our ToC and make adjustments based on evaluation of intermediate outcomes and feedback.

There are many assumptions inherent in any ToC; *Figure 1.2* below, illustrating WLE's impact pathways, specifies eight critical assumptions. At a deeper level, the following three assumptions are at the core of our ToC:

1. **Interventions must be responsive to the agro-ecosystem, socioeconomics, gender dynamics and political economy of the landscapes in which they operate**

To enhance the effectiveness of the CGIAR research portfolio, WLE's research will support the analyses required to understand how to design better enabling environments and incentive frameworks, including building capabilities of women and lowering institutional barriers. These can be implemented by public, private and civil society organizations to extend interlinked agricultural intensification solutions at landscape scale. WLE will collaborate with PIM to combine its strong capacity in market and institutional analysis with WLE's expertise in NRM.

2. **Managing complex trade-offs and changes in policies, plans and finance mechanisms requires early and continuous dialogue and supportive institutions**

Moving scientific knowledge to real-world decisions requires iterative, interactive science policy processes. These include needs assessments, provision of evidence, active engagement with multiple actors from the start, supportive institutional arrangements, continuous dialogue, and institutional capacity development. WLE will contribute research-based solutions and participate actively in engagement and advocacy processes, but clearly we are not the final decision maker. Measuring the impact of policy and NRM research is especially problematic, as various studies commissioned by SPIA have demonstrated (e.g. Walker et al. 2010; Merrey 2015). WLE will continuously assess and evaluate our effectiveness in terms of influencing desired outcomes and, where needed, commission impact assessments. When necessary, WLE will adjust its ToC, strategies and impact pathways, including engaging with new partners that can make a difference.

3. **Major changes in behavior are needed to transition to highly productive sustainable intensification of agriculture**

Multiple actors and institutions play different roles in the creation and management of sustainable agro-ecosystems for food security and poverty reduction. CGIAR is one of many players. WLE will develop better understandings of the values, beliefs and norms that generate behaviors at individual and collective levels. WLE will use these insights to identify the most promising change agents, opportunities, incentives and potential partnerships to increase the likelihood of achieving significant institutional or behavior changes, including identifying promising opportunities to make women and youth major stakeholders in these transitions.

In many landscape contexts, there are good opportunities to encourage incremental changes that lead to sustainable improvements in production, incomes and equity. Much of the CGIAR's research falls into this important category. However, in order to achieve the ambitious targets reflected in the SDGs and the CGIAR grand challenges, it will also be critically important to identify opportunities for transformative change. Identifying and even testing such transformations at a small scale are rather challenging. Scaling them out will require major leaps in knowledge, values and attitudes as a basis for implementing entirely new policies, investments and management practices. These transformations are precisely what WLE aspires to support.

Figure 1.2 is a representation of four key impact pathways, and four types of measurable outputs and outcomes that are part of WLE's ToC. The four main outcomes are: 1) awareness (including knowledge and attitudes); 2) implementable policies; 3) appropriate investments; and 4) uptake of solutions. Each flagship targets one or more of these kinds of outcomes which WLE expects will contribute to achieving CGIAR SLOs and targets.

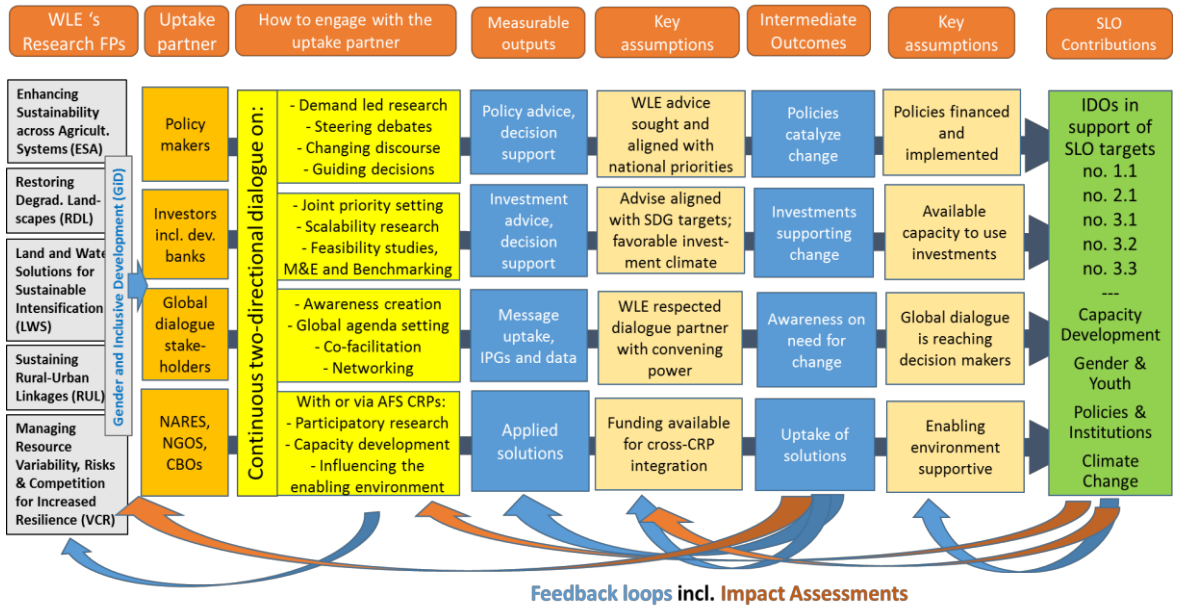


Figure 1.2 Key Impact Pathways of WLE's Theory of Change

Such figures inherently over-simplify complex realities and appear more linear than they really are. There are multiple feedback loops and synergies beyond those shown, including unanticipated influences on change processes across different impact pathways. Our main intervention targets will include: 1) **national policymakers** to influence changes in behavior at scale; 2) **national and international investors**, such as the private sector, development banks and foundations; 3) **Global development dialogues**[6], e.g. international steering committees, UN task forces and technical advisory groups; and 4) collaborating **AFS CRPs** to co-invest with national agricultural research and extension systems (**NARES**), **NGOs** and other organizations engaged in NRM solutions for sustained agricultural intensification. WLE has convened a subgroup within CGIAR centers and CRPs to establish

[6] Based on our engagement in various global dialogues, WLE will continue to represent CGIAR on the operationalization of the SDGs. In Phase 1, with our partners WLE is involved in target setting and indicator development for SDGs 2, 6 and 15. In Phase 2, WLE will focus on research supporting indicator monitoring across scales in target countries.

a platform to share information on SDG indicators, identify CGIAR research linkages to country level SDG implementation, and identify areas for working cooperatively.

Building on past achievements, WLE will focus on the following mechanisms and pillars for facilitating change:

1. **Evidence:** WLE will conduct research and apply institutional and modeling analyses to understand trade-offs and synergies of integrating and scaling sustainable NRM practices and technologies and impact evaluation tools to assess the impacts and drivers of scalable solutions. This work will produce important international public goods (IPGs). **Key partners:** *AFS and ICRPs, national research agencies, and global research and development partners.*
2. **Solutions:** Drawing on evidence produced through our analyses and impact evaluations, WLE will develop scalable gender-responsive solutions and tools for sustainable intensification of agriculture at landscape scale. These will include decision-support tools for scenario analysis of the complex interactions of agricultural practices and socioeconomic and political systems in different agro-ecosystems. WLE will pay special attention to understanding how other sectors influence decisions on resources used by agriculture, for example, the urban, energy, environmental and industrial sectors. Solutions will be tested in specific contexts to determine potential outcomes. These are also important IPGs.[7] **Key partners:** *AFS and ICRPs, national research agencies, global research and development partners, and farmer and community organizations in the landscapes.*
3. **Changed perspectives:** WLE will engage with multi-sector actors (public and private) through national, regional and global dialogues for shared learning to develop and foster investments in tested evidence-based solutions. It will also work to engage men, women, and youth to become stakeholders in sustainable intensification. **Two types of key partner/engagement actors:** *those who are part of the advocacy process, such as NGOs and farmer organizations, and those whose views we aim to influence, such as policymakers, development banks and the private sector*.
4. **Action**: WLE will promote capacity development, institutional innovations, and incentive frameworks to address trade-offs and reduce social, economic and gender inequalities, while enhancing NRM and ecosystem services for poverty alleviation. **Key partners**: *policymakers*, d*evelopment partners, government agencies, private sector, and NGOs.*

1.0.4 Gender

WLE developed and implemented a comprehensive Gender Strategy during Phase 1. It focuses on critical research issues related to gender equity and NRM, and on promoting inclusion of gender issues in national, regional and global forums. Taking a *gender transformative approach*, the strategy argues that greater gender equality in NRM will lead to more sustainable social and economic benefits. This has become one of WLE's higher-level hypotheses in Phase 2. Based on this strategy, WLE's gender research during Phase 1 has sought to: 1) validate and test the main argument that gender equality leads to achieving greater socioeconomic benefits; 2) deepen our understanding of gender-related cultural, social and power dynamics impeding greater equality; and 3) identify practical means by which women and men can share the benefits of control and management of landscapes and ecosystems.

[7] Examples of solutions and tools developed by WLE during Phase 1 can be found at https://wle.cgiar.org/solutions.

During Phase 2, WLE will: 1) continue to inform practice through research to achieve deeper understandings of gender relations and the management of agro-ecosystems at landscape level, through understanding power relations and capabilities linked to NRM; and 2) work with uptake partners to promote greater and more equitable opportunities and benefit streams. Strategic research will identify and, with uptake partners, test new opportunities and strategies to increase women's access to productive resources and strengthen their participation as full decision makers.

The work will be led by WLE's Gender and Inclusive Development (GID) theme, which crosscuts and directly supports all five WLE Flagships, integrating gender-responsive approaches into research designs through to implementation, to sharing findings and influencing policies (see Annex 3.3). GID will steer and support the WLE flagship gender work, which is explicitly included in the flagship programs (as well as staff and budgets). GID will integrate gender into their overarching questions and will synthesize results from the flagships and elsewhere to answer critical gender-equality questions to inform practice and further research. This will often be done with boundary partners along the impact pathway, such as the Asian Development Bank (ADB), Food and Agriculture Organization of the United Nations (FAO), and International Fund for Agricultural Development (IFAD). This work will also be coordinated with complementary, largely field- and household-level, gender research by AFS CRPs and the Natural Resource Governance Flagship of the CRP on Policies, Institutions and Markets (PIM).

Guided by WLE's theory of change, we will make every effort to ensure that the empirical evidence generated influences decision makers towards adopting institutional approaches and practices that deliver more gender-equitable and inclusive outcomes. Two assumptions will guide our strategic gender research:

1. Change is a long-term and multi-pronged process requiring careful selection of strategic research areas and uptake partners to enable significant gender-transformative outcomes; and

2. The focus will be on social institutions and constraints beyond the household level, based on an understanding that gender-equitable institutions are key to the capacity of individuals to define and act effectively on shared NRM and to access, manage and use specific technologies.

WLE's Phase 2 research will contribute directly to achieving the goals of the CGIAR SRF by identifying strategies to overcome gender-based institutional barriers. We will address the difficult gender issues raised by the SRF's "societal grand challenges": climate change, competition for land, soil degradation, overdrawn and polluted water supplies, nutritious and diverse agri-food systems and diets, and new entrepreneurial and job opportunities. Women face additional challenges, for example, the feminization of agriculture as a result of male migration, which adds significantly to their work loads. WLE recognizes that gender transformative approaches are key to meeting these challenges and unlocking the potential for increasing productivity, market access, incomes, and food and nutrition security. An approach that pays special attention to gender, rather than taking gender issues for granted or treating them as separate from other research issues, will lead to win-win outcomes for men as well as women.

Gender-based power relations and capabilities affect access to resources in rural communities and substantially shape how they are used. Therefore, these will be WLE's entry point. Our research has already demonstrated that gender power relations and capabilities influence the ability and willingness of intermediary NRM-related institutions to develop and deliver equitable and effective NRM strategies. The biophysical and social efficacy of their strategies depends on how they involve users, both individually and collectively, in interventions. If WLE is to assist communities to sustainably

develop and manage resources while ensuring that women are empowered to participate effectively, it is essential to understand how gender relations operate within institutions, and to identify ways to build gender equity into decision-making processes. WLE's work will focus on 'middle-level' intermediaries, such as community-based organizations, to address power dynamics and inequalities in the management of water, land and ecosystems. WLE will also focus on constructing and supporting greater capabilities of both women and men, and young as well as mature people, that can enhance sustainable intensification and the generation of value from shared landscapes and ecosystems.

Three critical research questions directly linked to WLE's Theory of Change and impact pathways will guide gender research in Phase 2:

1. How do gendered power relations affect access to, and management of, water and land as productive resources in shared landscapes, in particular, through intermediary-level institutions?
2. What kinds of approaches could be effective in directly or indirectly overcoming gender-based power relations and barriers to achieving equitable opportunities for realizing the SRF goals?
3. What specific gendered capabilities need to be strengthened within potential change agents to support their work? How can these capabilities be scaled up in national and regional agricultural development and NRM programs?

In addressing these questions, WLE will build on an established body of social and political science research on power, local development, resource management, and rural development transitions, and on capabilities, to open opportunities for women as well as men to be able to change the dominant rules and relationships governing resource use and distribution. Our key strategy lies in tying together the ability to access and manage natural resources with cropping system production processes, ecosystem services and values chains, and analyses of power and capabilities and their influence on practice and policy narratives.

WLE's gender research will engage directly with gender research by partner AFS CRPs, whose focus is largely at farm and household levels; and we will collaborate closely with PIM and CCAFS, particularly on landscapes, value chains and climate change. PIM's gender research works at multiple levels, with a strong emphasis on issues such as equitable access to markets, information and NRM governance, and land tenure systems within shared landscapes. WLE's comparative advantage lies in integrating work at landscape and national levels with multi-disciplinary research on water, land, soils and biodiversity.

Gender research design and methods

Research will be conducted within and through the five WLE flagships, with initial priority on Regenerating Degraded Landscapes (RDL) and Land and Water Solutions for Sustainable Intensification (LWS). WLE will analyze options for supporting equality in access and decision making to water and land management, based on solutions under development within these flagships. WLE will also examine issues of power relations within key intermediary institutions, and identify critical capabilities needed to effectively manage and harness natural resources for sustainable intensification of different crops within production systems.

Regarding gender and power issues, WLE's core analysis will build on emerging methods of political economy analysis which unpack "the visible, hidden and invisible dimensions of relationships between key actors involved in producing (or blocking) meaningful development changes" (Acosta and Pettit 2013), in our case with specific attention to gender and power in shared resource landscapes. This builds on a series of influential analytical frameworks developed by and for key development agencies

(e.g. World Bank, UNDP, USAID, DFID, SIDA, DGIS) to identify the actors, institutions and processes that influence, and often constrain, the effectiveness of development programming. WLE will use the drivers of change approach, which provides a dynamic framework that maps institutional landscapes but also facilitates understanding of interactions between different actors and how these impact change (Unsworth 2002). A critical emphasis lies in the informal institutional environments as hidden, yet critical, drivers of (or obstacles to) change beyond formal governance structures (DFID 2009).

Key sub-questions for power relations:

- What are the most relevant sets of institutions in each landscape context (institutional mapping)?
- What are the gender-specific elements of these institutions (membership group, purpose, rights frameworks, decision levels, links to outcomes), how are they barriers for women to engage, and how could these barriers be overcome?
- What efforts have taken place in other contexts to tackle these challenges that are relevant to WLE contexts? What, if any, were the positive/negative outcomes?

On capabilities, WLE will build upon, and complement, the work of the Gender, Agriculture, and Assets Project (GAAP) led by IFPRI. Using the understanding that capabilities are the ability of people to achieve outcomes with their assets and resources (Bebbington 1999; Bailey et al. 2016; Moser and Steiner 2015), and understanding that these are often gendered, are important steps in opening up NRM opportunities for women. As access to water is always mediated by a technology (buckets, pumps, pipes and, gates) and a social system (water users' association, social norms), women are often not able to use these assets to their benefit. Researching the capabilities needed to do so is an important entry point to enable women as well as men to benefit from, and be able to manage, this resource. For land, degradation is closely linked to tenure; however, tenure reform alone will not empower women to engage in regeneration (GLF 2015). The question here is, which capabilities and competencies are needed to ensure this? Our research will examine how these capabilities are facilitated (or not) by local institutions, and how institutions need to coordinate individual human capital/capabilities and collective capabilities as these will determine how and what a man or a woman can mobilize to access, manage and benefit from natural resources. This will lead to an actionable agenda to be pursued by flagships.

Key sub-questions for capabilities:

- What capabilities do men and women need to ensure they can achieve their desired outcomes? How can these be strengthened for sustainable intensification?
- What kinds of institutional arrangements are most effective in supporting people to fully realize their capabilities?
- How can such institutions be encouraged and facilitated to respond effectively and equitably to beneficiaries - particularly women - seeking to realize their NRM goals?

For research design, both power relations and capabilities will need significant upfront research to develop a framework applicable to NRM. The development of this framework will be led and facilitated by the GID team. GID will work closely with flagships to adapt and apply the framework in order to address gender issues specific to the flagship questions, some of which have already been identified (see gender sections in flagships). Using this framework, data will be collected on the various institutions managing natural resources, the rules and norms governing them, the gender barriers inherent in them, and the capacities and capabilities women and men currently have and those they need to achieve the transformation required to develop equitable sustainable intensification approaches. Research methodologies will include institutional, power and political economy analysis

based on case studies, participatory action research with key intermediary institutions, stakeholder and ethnographic surveys, and quantitative analysis, including field surveys and social network analysis (further description can be found in Annex 3.3).

Expected research outputs and outcomes

Outputs, which will all be IPGs, will include an analytical framework integrating gender effectively into NRM research; recommended strategies for building strong gender-responsive institutions and enhancing the capabilities of individuals – both men and women – within these and related institutions to support gender-equitable sustainable intensification of different agro-ecologies. These outputs will provide research-based insights into the potential net benefits for women and men; and support ongoing dialogues led by the flagships and their partners to guide strategic adjustments to the research programs and ToCs to ensure each is gender-responsive. WLE will develop a strong evidence base, engage in constructive dialogue on public policy options, and produce research outputs and other tools to assist decision making on gender transformations at different levels. The outputs will contribute directly to the CGIAR Global Research Priority, Gender and Inclusive Growth, and to the crosscutting themes: gender and youth equity and inclusion, strengthening policy and institutional enabling environment, and developing capacity of national partners and beneficiaries.

SDG 5 calls for achieving gender equality. WLE will contribute to this by addressing two sub-IDOs: 1) gender-equitable control of productive assets and resources, and 2) improved capacity of women and young people to participate in decision-making. WLE's gender outcomes will largely be achieved by making gender a central focus of flagship research. We recognize that there is a great deal of inertia in socially-defined gender roles, and with its modest resources it cannot achieve dramatic gains in just six years. However, we will work on improving women's capacities to participate in decision-making by targeting our capacity development activities towards women at all levels, from professional and farmer-level. For example, RDL will train at least 100 professionals to apply its methods for targeting restoration options, risk assessment, and monitoring and evaluating impacts in six countries; we will make every effort to ensure at least 50% of those trained are women. Similarly, as described in detail in sections 2.1-2.5 below, each flagship has identified specific outcomes and targets, many of which have a gender dimension. For example, LWS has set a target of "adoption of agricultural land and water management solutions benefit two million households in WLE and AFS CRP landscapes, of which 30% will be female, and improved irrigation system management benefiting over one million farm households of which 30% will be female. RUL has a target of 0.5 million wastewater-using farm households understand safer irrigation practices; we will aim to ensure that at least 30% are women-headed households. RDL aims to have 1.5 million farm households using restorative and preventative land management practices – we will aim for a target of 30%. More important than these targets will be the increased awareness of WLE's research-based options to overcome unequal power relationships and inform future policies, investments and implementation strategies on how gender-equality can be achieved over the next decade and beyond.

1.0.5 Youth

WLE is developing a youth-inclusive research agenda; the current version of the strategy is in Annex 3.4. Our goals are to ensure young women and men are recognized as major stakeholders and to equip them to be active participants in agriculture and NRM. WLE will work with youth to raise their confidence, promote youth leadership, and enhance their ability to build successful careers and have an active voice in decision making in agriculture and NRM. A two-pronged approach is required: at an individual level, appropriate capacities and capabilities need to be developed to take up irrigation and other agricultural and NRM technologies. At a structural level, research will identify opportunities for

policy and institutional reforms to enable youth to benefit from water, land and ecosystem access. The aim will be to identify how to enable rural and peri-urban youth to be entrepreneurial farmers, managers and professionals. The four research questions that will guide WLE's work on youth are:

1) What are the structural opportunities and constraints for youth to access and invest in NRM? How can youth be facilitated and encouraged to bring their ideas to the table and become part of the solution to achieve sustainable NRM?

2) How can capacity development of youth be promoted?

3) How can resource access and income-generating opportunities be promoted for youth?

4) How can youth engage effectively in natural resource governance and policy decisions?

Implementation will be initiated by developing a full youth strategy, supported and coordinated under the GID core theme. WLE will develop this strategy in collaboration with AFS CRP partners and following a process of engagement with youth representatives. WLE and its partners will then jointly seek W3 and bilateral support to implement activities that explicitly include youth, including building a stronger youth agenda into the WLE flagships.

1.0.6 Program structure and flagship projects

WLE focuses on identifying how to build resilient agricultural systems and functional landscapes that support the delivery of ecosystem services and contribute to equitable human development. Complementing research on commodities and value chains, WLE focuses on the sustainable management of water and land resources to establish well-functioning ecosystems while meeting food demands and achieving economic growth. Our approach will emphasize the multi-functionality of landscapes and exploring the trade-offs, costs and benefits of different pathways to sustainability at scale, including how other development agendas impact the agriculture sector.

In Phase 2, WLE will integrate Phase 1 knowledge with that of other CRPs to refine and answer critical research questions, develop solutions, gain insights into the enabling environment and support dialogue on balancing ecosystem requirements and agricultural intensification to sustainably reduce poverty.

The research is organized around five complementary flagships that emphasize NRM across scales and impact pathways to achieve SRF and SDG targets, supported by a Core Theme on Gender and Inclusive Development (GID) (*Figure 1.1*, above). While all flagships involve finding integrative solutions to complex problems, four are primarily thematic, while the fifth is primarily integrative.

The four primarily thematic flagships are:

1. ***Restoring Degraded Landscapes (RDL)***

The RDL Flagship will support governments and people to restore their degraded landscapes, enhancing ecosystem services and contributing to vibrant agroecosystems and the benefits they provide: food, energy, clean water, income and livelihoods. RDL will support achieving the SRF targets on land restoration and reduction in greenhouse gas emissions, the latter in collaboration with CCAFS. RDL will link with LWS to achieve the SRF target on water- and nutrient-use efficiency via carbon management, and will be supported by the RUL Flagship for nutrient recovery. Its main impact pathways will be supporting national restoration programs and associated investments via global and regional dialogues as well as via the ESA Flagship and the AFS CRPs in CGIAR target countries, targeting

SDGs 2, 13 and 15. For example, RDL will work with Dryland Cereals and Legumes (DCL)[8] on projections of land degradation risks, and the potential impacts of preventive and restorative intervention strategies, as well as assessments of the impacts of soil, water and biodiversity interventions for restoring landscapes. GID will support RDL to target women and youth.

2. Land and Water Solutions for Sustainable Intensification (LWS)

The factors that influence productivity of water and land resources under agricultural intensification are dynamic and complex. Agriculture is the largest user of land and water, and provides employment for over one billion people. **In collaboration with partners, LWS will develop and apply solutions for managing land and water in rainfed and irrigated agricultural systems that are sustainable at landscape scale.** The main impact pathway of LWS is through collaboration with AFS CRPs and other partners on improving water and nutrient management, while accounting for externalities, ultimately supporting SDGs 2 and 6. For example, LWS will collaborate with Livestock on intervention options for agricultural land and water management, and water supply and irrigation opportunities in livestock value chains across landscapes under mixed sustainable intensification. LWS will work closely with GID to empower women to be part of the solutions.

3. ***Sustaining Rural-Urban Linkages (RUL)***

With resource flows being increasingly determined by urban demands, food security and poverty are no longer only rural challenges (Reardon et al. 2014; Satterthwaite et al. 2010). Peri-urban areas are hot spots for farming system transformation and intensification as well as resource degradation and depletion (Harding et al. 2015). **RUL will address these challenges and opportunities for NRM at landscape level. Building on the business models developed in Phase 1, RUL's objectives are to optimize their implementation, maximize urban food security, identify new business opportunities for young women and men, and minimize the footprint of urbanization.** RUL will address the resource competition, pollution and opportunities for closing water and nutrient loops through resource recovery and reuse associated with peri-urban landscapes. It will support the restoration efforts of RDL and overall nutrient- and water-use efficiency at system level. RUL will also work on food waste across the value chains of selected AFS CRPs, and analyze business models for investors, which may offer significant opportunities for women and youth entrepreneurs. Examples of collaboration with AFS CRPs are: providing research data and business models for resource recovery reuse, and receiving quantitative assessments of waste generation and value chain economics (RTB) for cassava; and working with Livestock on business models and risks related to wastewater use for fodder production and energy recovery from slaughterhouse waste.

4. Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)

VCR aims to enhance the capacities of men, women, communities, governments and the private sector to reduce risks associated with rapidly increasing variability, scarcity and degradation of natural resources, water-related disasters and competing uses of water, land and energy, and to facilitate access to these resources by all. VCR will analyze options to optimize the availability of water within and across sectors in a context of increasing competition, and co-invest with CCAFS in developing and upscaling adaptation solutions at the landscape level to mitigate resource variability in support of policy decisions and investments in SDGs 6.4 and 13. VCR will address one of the major

[8] We acknowledge that DCL, or L&DC as it is now called, is still under development and review. If necessary, we will re-prioritize once the portfolio is finalized. For the purpose of the re-submission we have maintained the acronym DCL to refer to this CRP.

resource constraints of the next generation by leading a special initiative on groundwater solutions for policies and management practices. VCR will collaborate with AFS CRPs on mutually important topics, such as with FISH to provide data, tools and research on flooding in major deltas and floodplains to evaluate the role of water variability on inland fisheries, and analyze hydropower–fisheries trade-offs in selected river basins.

WLE's **integrating** Flagship is:

5. Enhancing Sustainability across Agricultural Systems (ESA)

Addressing the above challenges requires practical and effective collaboration across the program and with relevant AFS CRPs and ICRPs, working in CGIAR target and other developing countries. It means understanding the critically important role of social and gender equality, as pre-conditions for sustainable development. **ESA will integrate research findings to support development decisions and investments across commodities, sectors and scales by refining, testing and benchmarking sustainability indicators at scale, utilizing elements of the initial work on ecosystem resilience frameworks in Phase 1.** ESA collaborative research will contribute to SDGs 2, 6, 7, 13 and 15. ESA uses two key mechanisms: 1) a cross-CGIAR initiative to build on WLE research to refine, test and benchmark sustainability indicators for agri-food production; and 2) co-developing and coordinating integrated WLE-AFS CRP research combined with decision support analysis across disciplines. An example is collaboration with RICE on targeting and valuation tools that facilitate quantification of externalities of agricultural intensification at scale.

The crosscutting **Gender and Inclusive Development (GID)** theme supports all five flagships. **Its research will focus on identifying gender-based power-relations, barriers and dynamics in NRM, strategies to overcome these, and what gendered capabilities need to be strengthened to enable women as well as men and youth to gain access to resources and their benefits**. Through GID, WLE contributes to SDG 5 - achieve gender equality.

1.0.7 Cross-CRP collaboration and site integration

WLE complements the commodity and farm-level focus of AFS CRPs by working across multiple scales and sectors (agriculture, environment, land, water and energy). WLE's comparative advantage is that it looks at impacts across value chains and scales, and within a broader landscape and agro-ecosystem perspective. This perspective helps to identify synergies with other development sectors, potential leverage points, and ways to manage and identify the intended and unintended consequences of scaling out wider ecosystem services. WLE therefore complements and adds value to the work of AFS CRPs.

Details of the collaboration between WLE and other CRPs are provided in Annex 3.6, and summarized in *Figure 1.3* below. Some of the main aspects of this collaboration include:

- Co-development, testing and application of the portfolio-wide sustainability framework and indicators with and by the AFS CRPs (especially **DCL, Livestock, FTA**, and **RICE**), and national partners in specific CGIAR target countries (Nigeria, Tanzania, India, Bangladesh, Myanmar, Vietnam, Burkina Faso, Ghana and India), to benchmark and assess intensification scenarios and investments from a landscape perspective (delivers on sustainably managed ecosystems [IDO 3]). This is coordinated by the ESA flagship.

- Supporting AFS CRPs by developing integrative models, scenarios and trade-off analyses that inform decision-making and planning processes associated with sustainability. This includes

variability and risk analysis, and looking at land and soil restoration and soil carbon sequestration, with **CCAFS, DCL,** and **Livestock**.

- Exploring solutions and business models at scale. This includes work on rice and rice-fish systems (**RICE** and **Fish**), and developing business models for turning food and agro-industrial waste into usable assets (**RTB**, **A4NH, Livestock,** and **Fish)**.
- Cross-CRP collaboration on policies, institutions, governance, gender and youth, and equitable water and land tenure for sustainable NRM (with **PIM, FTA** and **DCL,** and the **gender network**).

Figure 1.3 Summary of CRP Collaboration with WLE (see Annex 3.6 for details)

WLE prioritizes efforts in CGIAR target countries within the four WLE focal regions (Greater Mekong sub-region, the Ganges, East and West Africa) to capitalize on established partner networks and uptake pathways (IEA 2016). These target countries are **Burkina Faso, Ghana, Nigeria, Ethiopia, Uganda, Tanzania, Bangladesh, India, Nepal, and Vietnam**. WLE has contributed to and participated in the integration process in all of these countries.

WLE and other CRPs have agreed to undertake joint activity planning, co-investment, and co-piloting of potential solutions, and are developing concepts for joint resource mobilization. An example is

WLE's continuing work with seven CGIAR centers representing at least seven CRPs on a CGIAR Advisory Committee in Bangladesh. Through this venue, all CGIAR centers plus AVRDC and IFDC meet with NARS and ministry officials. In Ethiopia, WLE has joined nine CGIAR centers collaborating within and with NARES. The State Minister of Livestock and Fishery opened the meeting in December 2015. WLE will also participate in, and foster, key communities of practice across the CGIAR portfolio, including being involved in the Big Data platform, gender network, and open access and communications initiative.

1.0.8 Partnerships and comparative advantage

Effective partnerships are critical at all stages of our impact pathway, from identifying research needs and testing solutions and tools, to generating evidence and influencing decision making. This is highlighted in our Partnership Strategy for 2014-2016, and was recognized as a programmatic strength by the IEA review (IEA 2016). The strategy has been revised (see Annex 3.1) for Phase 2 to take into account new priorities, such as collaboration with AFS CRPs and the focus on engaging finance and investment institutions.

WLE has divided its partnerships into two categories: strategic and implementing. The core *strategic* partners are the 11 participating CGIAR centers and FAO. Six CGIAR centers are identified as Tier 1 partners (IWMI, Bioversity International, CIAT, ICRAF, ICRISAT, and IFPRI), and five as Tier 2 partners (CIFOR, CIP, ICARDA, ILRI, WorldFish).

WLE also considers *strategic partners* as long-term partners that have common objectives and support change along the impact pathway. This includes CGIAR partnerships (see Annex 3.6) along with institutions that it works with in more than one flagship. Examples include: The Nature Conservancy (TNC), UNESCO-IHE Institute for Water Education, IFAD, and development banks such as the African Development Bank (AfDB), ADB and World Bank. Some representation from among these strategic partners will be included on the WLE Steering Committee in order to ensure greater synergy with related programs and initiatives.

WLE has established hundreds of *implementing partnerships* that work across functions from discovery, proof of concept to impact. These include: research partners, public policy partners, development partners, capacity development partners and private sector (see Annex 3.1 and table of partnerships). These are not discrete functions. Partners involved in scaling up are also part of the proof of concept stage and provide important inputs into the design of research.

Regarding research partnerships, WLE brings world-class science on ecosystems management that the CGIAR has not previously tapped. This includes: Stanford University's Natural Capital Project for Ecosystems Indicators; King's College London, Hubbard Decision Analysis; Wageningen University for trade-offs and decision analysis and gender; and INRA, CIRAD and IRD for soil-carbon research.

Similarly, WLE has a comparative advantage in engaging with environmental organizations that are crucial to bridging the environment and development divide. WLE works with these partners to ensure that agriculture is at the heart of global environmental discussions. Examples include: TEEB (The Economics of Ecosystems and Biodiversity), IPBES (Intergovernmental Platform on Biodiversity and Ecosystem Services), the Ramsar Convention on Wetlands, the Economics of Land Degradation Initiative (ELD), and the United Nations Convention to Combat Desertification (UNCCD).

IEA (2016) identified WLE's emerging convening power (its ability to convene diverse groups as well as to be invited onto multi-stakeholder platforms) as another important comparative advantage. We will work together with different actors (private sector, governments and conservation agencies) to enhance institutional capacities to manage agro-ecosystems at scale. Examples include benefit-

sharing mechanisms in Peru and the Tana Water Fund in Kenya. As mentioned elsewhere, WLE has developed unique partnerships with donor investors to influence large-scale investments, particularly in land restoration and irrigation. WLE has also developed important partnerships with regional advisory bodies, such as the Nile Basin Initiative (NBI), Volta Basin Authority (VBA), Southern African Development Community (SADC), Mekong River Commission (MRC) and the Southern Agricultural Growth Corridor of Tanzania *(*SAGCOT). In addition, through partnership networks such as UN-Water, WLE and IWMI are engaged in providing research results to support the development of the targets for SDG 6.

1.0.9 Evidence of demand and stakeholder commitment

Demand for WLE research comes from global processes (SDGs, Climate Change, Biodiversity), international finance institutions, and policymakers at the regional and national levels. Annex 3.13 contains a list of organizations that have expressed strong support, and letters of endorsement from various key partners.

Because sustainability is at the heart of the 2030 development agenda, WLE's main problem sets are defined within the SDG framework, as described above in Section 1.0.2. At the national level, more than 100 countries have National Sustainable Development Strategies, and at least 170 voluntary sustainability standards are being implemented by the food and agriculture industry (FAO 2013).

Transferring natural resource research findings into large-scale implementation across landscapes involves commitment of significant long-term financial and human resources. In many cases, joint investment programs of governments and the IFIs, including ADB, AfDB, IFAD, Islamic Development Bank (IsDB) and the World Bank, provide such resources. WLE, in many instances, forms knowledge partnerships with such investors. Examples include participation in the World Bank/CILSS task force developing the Sahel Irrigation Initiative; work with ADB on assessing options for "More Food – Less Water" in South Asia; assistance to IFAD to identify opportunities for smallholder irrigation in Africa; and the development of the Agricultural Strategy for IsDB in Central Asia. WLE research is also requested by large restoration initiatives, such as those of GIZ, which called on the RDL Flagship for research on the 'climate smartness' of soil rehabilitation measures; similarly, World Resources Institute (WRI) requested technical support to 20X20 Initiative implementation countries funded by the Inter-American Development Bank.

WLE will continue to collaborate with governments and boundary partners to craft our research agenda. Indicative examples of demand and commitment include: The Federal Ministry of Agriculture and Rural Development (FMARD) of Nigeria approached WLE through IWMI in 2012 and 2015 for flood inundation products, which they could use to target areas of cultivation after catastrophic flooding. In Sri Lanka, the Disaster Management Center (DMC) requested IWMI to provide information on the extent of the 2015 drought, to facilitate and target compensation for crop losses. Likewise, the RUL Flagship signed three separate MOUs in Sri Lanka with ministries to improve waste management. In India, the National Disaster Response Force of India asked IWMI for detailed inundation information on the 2015 floods in Chennai.

Private sector actors also solicit our advice and solutions. Examples include Nestlé, Jain Irrigation, Sir Ratan Tata Trust, and hydropower companies. WLE recently signed a MOU with the Judge Business School to translate our business model results and lessons learned into course material for an open-access curriculum.

WLE has developed extensive networks and commitments in its focal regions. IEA (2016) concluded that "extensive stakeholder consultations have demonstrated that the demand for such research is

strong at all levels." This is evidenced by the Australian Government providing USD 13 million in bilateral co-funding in the Mekong Region. This success is also evidenced by the fact that the Global Resilience Partnership (USD 150 million investment), convened by the Rockefeller Foundation, USAID, and SIDA, requested our staff to guide a similar competitive and demand-driven approach for its own research for development calls.

At the **international level,** WLE's research is well respected and in demand by a range of United Nations agencies. WLE provides crucial information to UN-Water's initiative on SDG 6 on water. Our data and tools are sought by international agencies, such as FAO's AQUASTAT database and various water quality and wastewater initiatives of UNEP and WHO.

1.0.10 Capacity development

WLE plans capacity development (CapDev) interventions at each stage in its impact pathway to strengthen the capacity of partners to engage in research processes and to effectively use research at multiple scales. The **discovery stage** of research requires capacity to innovate, strengthening of institutions, and development of future research leaders, as well as development of innovative learning materials and approaches. At **proof of concept and piloting stage**, the capacity to innovate, institutional strengthening, and organizational development are needed. For **scaling**, innovative learning materials and approaches are needed, as well as institutional strengthening and capacity to partner. WLE will approach CapDev as an entry point for effective engagement with most of its key uptake partners. CapDev interventions at multiple levels are mutually reinforcing and expected to result in higher, sustained capacity to solve key development challenges and deliver measurable development outcomes. WLE CapDev targets include NARS, NGOs and CBOs, global stakeholders, financial institutions, policymakers, technical experts, regulatory bodies, and planning agencies. WLE will collaborate with CapDev partners to strengthen individual and institutional capacities. WLE will strategically utilize four high-intensity and two medium-intensity elements. However, WLE recognizes all elements as complementary and intends to combine elements within a non-linear process of accumulated learning to achieve higher capacity. *Table 1.2* provides details on WLE's CapDev priorities and indicators for tracking progress.

Table 1.2 WLE's CapDev Priorities and Indicators

Strategic CapDev Actions			
Element	**Intensity of implementation of chosen elements (expect no more than 3-4 would be high)**	**Give an indication of how chosen elements will be implemented (Note: more space is available for full plan in Annex 3.2)**	**Indicate any Indicators – from CapDev Indicators document or other – that could be used to track progress and contribute to CapDev sub-IDOs**
Capacity needs assessment and intervention design strategy	Medium	Assess capacity needed to implement new frameworks, use decision-support tools and apply indicators equitably	• Adapted needs assessment methodologies available in published form for CRP

Strategic CapDev Actions			
Element	**Intensity of implementation of chosen elements (expect no more than 3-4 would be high)**	**Give an indication of how chosen elements will be implemented (Note: more space is available for full plan in Annex 3.2)**	**Indicate any Indicators – from CapDev Indicators document or other – that could be used to track progress and contribute to CapDev sub-IDOs**
Design and delivery of innovative learning materials and approaches	High	Design and pilot learning materials at different levels (farm, landscape, basin) for new or adapted technologies and practices; train boundary partners to use research results for scaling	• Number of people trained • Number of partner organizations who use materials and approaches
Develop CRPs' and centers' partnering capacities	Low		
Developing future research leaders through fellowships	Medium	Enhance young scientists' skills in conceptual approaches using new, innovative methods	• Number of early career scientists participating in CRP research • Number of scientific publications accepted for fellows, students, and trainees • Number of research proposals involving fellows and post-docs
Gender-sensitive approaches throughout capacity development	High	Invest in greater inclusion of gender-sensitive methods for training on research and engagement approaches; create opportunities for women to be research leaders and champions	• Proportion of funding for young women researchers in developing countries • Number of CapDev activities in gender approaches initiated • Funding made available for design/review of gender-sensitive approaches in CRP and partner programs, projects, policies
Institutional strengthening	High	Enable effective use of relevant research results for analysis, decision taking and planning	• Number of policy- and/or technical-oriented knowledge events targeting strategic partners/stakeholders • Number of policy decisions taken (in part)

Strategic CapDev Actions			
Element	**Intensity of implementation of chosen elements (expect no more than 3-4 would be high)**	**Give an indication of how chosen elements will be implemented (Note: more space is available for full plan in Annex 3.2)**	**Indicate any Indicators – from CapDev Indicators document or other – that could be used to track progress and contribute to CapDev sub-IDOs**
			based on engagement and information from CRP
Monitoring and Evaluation of capacity development	Medium		• Number of flagships that conduct M&E of CapDev activities • Number of CapDev innovations adopted across programs • Number of programs/ projects which capture lessons learned for replications/upscaling
Organizational development	Low		
Research on capacity development	Low		
Capacity to innovate	High	Implement innovative approaches to co-develop new technologies and practices: multi-stakeholder platforms to strengthen innovation capacity of partners and end-users	• Number of multi-stakeholder platforms facilitated by the CRP • Adaptation, adoption and spread of innovation associated with participating groups, platforms, networks

Budget and Resource Allocation						
Budget for CRP	**The CRP as a whole and all flagships will meet or exceed the 10% benchmark for CapDev investments (enter exact USD or % figure here). Annex 3.2 provides a breakdown of the budget. The figures below reflect the estimated six year budgets for each flagship, and management & support costs.**					
Budget for Flagships/ other (USD):	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**	**Management & support budget**
	8,271,000	7,421,000	8,945,000	9,822,000	7,651,000	95,000

1.0.11 Program management and governance

The WLE governance structure was highly regarded by IEA's 2014 CRP Governance and Management Review, noting that it had a balanced and independent governance body. Several other CRPs have now followed this model, which is fully aligned with the Fund Council's guidance. The draft IEA (2016) evaluation of WLE finds that "the operational management of WLE is very good" and has made some useful recommendations to improve the relationship between the strategic and operational leadership. These are addressed by this proposal. The review also identified the necessity to review operations in the context of reduced funding; this has already started in Phase 1. The reporting structure of WLE is illustrated in *Figure 1.4.*

The independent **Steering Committee** (SC) provides scientific direction and strategic oversight. It formulates recommendations on priorities, work plans and budgets for final consideration and approval by the Lead Center Board. It also undertakes periodic reviews of risks related to achieving program outcomes, and assesses the continued relevance of assumptions underlying the ToC. Excluding two *ex-officio* members, the SC comprises six to eight full members who are well respected in their fields. The majority of members are independent of CGIAR, and one of these independent members is selected as Chair. Members' expertise spans research, uptake and capacity development and will be strengthened further in Phase 2 in areas of political and institutional economy, as recommended by the IEA review.

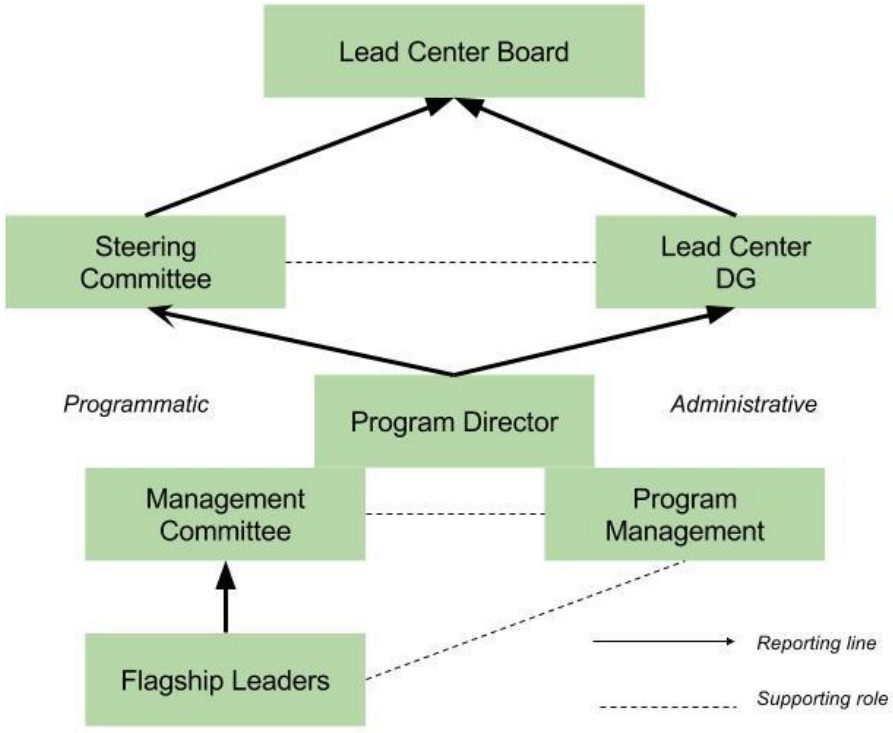


Figure 1.4.WLE Program Management and Governance Structure

As existing members complete their terms, replacements will be identified to maintain the distribution of skills across the research-for-development spectrum, including private sector experience, while maintaining gender and regional diversity. FAO, a key partner, will continue to be represented on the SC. Representation of partner centers includes a maximum of two program committee members of partner center Boards, one of which is from the Lead Center Board (not the Board Chair). The other will be selected by Tier 1 centers (see below). These Board representatives will reflect the perspectives

of the Tier 1 partners. The Director General of the Lead Center and the **WLE Program Director** are *ex officio* members and act as resource persons. The Program Manager is the Secretary to the SC. The SC Chair holds regular briefing calls with the Lead Center Board Chair as well as the Program Director, and assesses the performance of the Program Director on programmatic aspects. Legal and fiduciary responsibility remains with the **Lead Center, IWMI,** and its Board of Governors**.**

In accordance with the Phase 2 portfolio guidance, WLE has identified six strategic **"Tier 1" CGIAR partners** (see Section 1.0.8) who will actively participate in the development and promotion of WLE as members of the **Management Committee** (MC). The MC is responsible for reviewing WLE planning and monitoring processes; ensuring effective and strategic results-based management; making decisions on partnership and resource allocation; and committing to and actively mobilizing strategic funding for research projects under WLE. It makes recommendations on WLE's science agenda, strategy, and budget for consideration and endorsement by the SC, and final approval of the Lead Center Board. The MC is coordinated by the **WLE Program Director** with operational support from the Program Manager, and comprises the co-Flagship Leaders, the GID Coordinator and the M&E Coordinator.

Tier 2 partners (currently CIP, CIFOR, ICARDA, ILRI, and WorldFish) will participate in WLE in other ways, such as engaging in specific areas of WLE research, either in individual flagships or in specific research projects, often in collaboration with other CRPs, or participating in country integration activities on behalf of WLE. Centers could potentially move from Tier 2 to Tier 1 participation in WLE during Phase 2 as circumstances and priorities evolve. *Table 1.3*provides further details on the criteria for Tier 1 and Tier 2 membership of WLE. Although Tier 2 partners are not expected to play a major role in management or governance of the program, their senior management will occasionally be requested to contribute to strategic discussions. Following the successful development of external partnerships in Phase 1, WLE will continue to work closely with non-CGIAR partners across the program. FAO and RUAF, in particular, having been identified as key strategic partners within individual Flagships.

Table 1.3 Criteria and Expectations for Tier 1 and Tier 2 Partner Centers in WLE Phase 2

Tier 1 Partner Centers	**Tier 2 Partner Centers**
Center assigns research leaders to actively contribute to WLE, specific flagships or clusters of activities. This includes leadership of aspects of the proposal development.	Co-develop, co-manage and co-fund joint research that is aligned with WLE, which could be aligned with other CRPs or independent of them. WLE welcomes agreements with individual centers as part of joint research collaborations with other CRPs.
Flagship Leader actively participates in MC meetings, and ensures that center management is aligned with and supports WLE activities. Centers would be expected to proactively support minimum standards of science quality, including ethical review and compliance, communication and knowledge management, plus aligning policies and procedures to comply with CGIAR policies on intellectual property and open data, and technical and financial reporting systems.	

Tier 1 Partner Centers	Tier 2 Partner Centers
Active center participation and responsibility in CGIAR country coordination/site integration actions on behalf of WLE in countries in which they have offices and staff.	
Active center participation in relevant communities of practice and other cross-portfolio initiatives.	
Active center engagement in WLE communication and knowledge management, ensuring attribution to both center and WLE.	Agreed and appropriate joint communication and acknowledgement of contributions of different parties in agreements.
Senior management makes itself available for periodic management discussions (largely virtual).	Reasonable availability of senior management for periodic (semi-annual or annual) management discussions (largely virtual)
W1 and W2 funding and spending for the center work plans is agreed upon with WLE management, following CGIAR guidelines, as documented in the program participant agreement (PPA). Designation as a Tier 1 partner does not imply a particular allocation of W1/W2 funding. W3-bilateral fund-raising is coordinated in advance with WLE flagship research priorities.	All partner centers will be eligible to apply for any W1/W2 funded activities that are commissioned or internally competed through WLE. This would primarily be the integration activities within the ESA flagship, but also in specific strategic activities within the other flagships.
Center meets or exceeds agreed program-relevant resource mobilization targets for W3-bilateral funding. As the portfolio is presently envisioned, the CRP will need to raise at least 80% of the total program funding in the form of strategically relevant W3-bilateral funding. Tier 1 partners will need to raise bilateral funding proportional to the program-level requirement, which may be revised year on year.	

Each partner center nominates one **WLE focal point** to act as the conduit for all communications on science, strategy and management, and to facilitate interactions for WLE activities between the **Program Management Unit** (PMU) and their own center. These center focal points are accountable to both their center and WLE management. For efficiency, it is expected that for partner centers these focal points would be their MC member.

The PMU is responsible for day-to-day coordination and administration, as well as engagement with other global and regional programs, and internal and external communications. Led by the Program Manager, it consists of a small dedicated group of staff with skills in management, coordination and administration; knowledge management and communications; and monitoring, evaluation and learning. The PMU is supported by the corporate services and resource mobilization staff of the Lead Center and other partner centers, as well as specialists on capacity development, intellectual asset management, data management and other relevant crosscutting issues. The Program Manager reports to the Program Director and acts as a resource person to the MC. In response to comments

from the IEA review, the separation of duties of the Program Director and Program Manager has been clarified, ensuring the Program Director has time to focus on the strategic leadership and outreach elements of the program.

The role of **Flagship Co-Leaders/Leaders** (FLs) is to identify, direct and promote the science on which WLE depends for solutions of national, regional and global significance. This includes working across disciplines, centers and themes, since the area between disciplines and centers is where much of the innovative science is done. FLs are expected to play a significant role in raising bilateral/ W3 funds and to develop new and existing partnerships with development partners. WLE's FLs are dedicated senior research staff with strong publication records, all of whom have been involved in WLE Phase 1. WLE follows a co-leadership structure among Tier 1 partners for VCR, RDL and LWS, in which each co-Leader has an equal role in leading the Flagship research portfolio. As RUL is smaller, it is managed by a single leader. In the case of ESA, WLE has recruited an individual who will be responsible for the cross-flagship integration in partnership with one Tier 1 partner. As a result, out of the five Flagships, Bioversity, CIAT, ICRAF, IFPRI, ICRISAT and WLE each co-lead a flagship, while IWMI leads one flagship and co-leads two others. Flagship Leaders are supported by **Cluster of Activity (CoA) Leaders.**

The CVs of the new Program Director as well as the FLs, CoA Leaders, PMU members and other Principle Investigators and Senior Scientists are provided together with a staff list in Annex 3.7. WLE has completed a detailed review and update of the ToRs of all governance and management entities from those of Phase 1, including steps to address recommendations in the final IEA review report. The update includes an Accountability and Responsibility Matrix to inform key decision-making points in the Program, following a recommendation from the CGIAR IAU Audit.

1.0.12 Intellectual asset management

In compliance with the CGIAR Principles on the Management of Intellectual Assets (IAs), all research results produced by WLE are International Public Goods (IPGs), enabling maximum possible global access. In order to ensure effective management and implementation of Intellectual Property (IP) rights, as well as fully complying with the CGIAR IA principles, WLE will follow the policies and procedures of the lead center (IWMI) on IA management and information and knowledge dissemination to ensure global Open Access. Annex 3.9 provides a detailed description of WLE's approach to managing IAs summarized as follows:

- The IWMI Legal and Contracts Officer reviews all WLE-related agreements to ensure full compliance with CGIAR IA principles.
- Partners are informed in advance and during the negotiation of contracts, agreements and MOUs of CGIAR and IWMI requirements with regard to the sharing of IP rights and related Open Access provisions.
- WLE Partner Agreements contain clauses on Intellectual Assets (IAs) and Intellectual Property (IPs) that are in compliance with the CGIAR Principles on the Management of IA.
- All other partner agreements also include required provisions to ensure the sound management of IAs and IPs in accordance with relevant applicable laws and best practices.
- A record is kept of Limited Exclusivity Agreements or Restricted Use Agreements in order to provide full justification to CGIAR that such agreements are contributing to the furtherance of the CGIAR vision. The same is done for Trade Marks reporting.

- All projects use a WLE project reporting template which includes a separate Section on IA issues highlighting important IAs that have been used for, and generated by, the project.

1.0.13 Open access management

The WLE Open Access and Data Management Plan, described in Annex 3.8, has been developed as part of the IWMI and WLE Open Access/Open Data Implementation Plan (OA/OD). This OA/OD Implementation Plan has been developed pursuant to the CGIAR Open Access and Data Management Policy (adopted in 2013), and the CGIAR Open Access and Data Management Implementation Guidelines (adopted in 2014).

Open Access and Data Management is a critical component for all stages of WLE's impact pathway. At the discovery level, WLE will collect, generate and share data efficiently amongst core research partners. At the outcome level, WLE intends to use models and decision analyses to inform decisions on water, land and ecosystem management. At the wider impact level, WLE will ensure that its data, models and tools are accessible through Linked Open Data to better expose publicly financed data.

WLE has established an open access policy and an open access repository through CG-space. WLE's ambition is to be fully compliant with Open Access guidelines during the first year of Phase 2 (2017). WLE is also in the process of implementing its OA/OD plan. This will include the establishment of protocols and procedures for flagships and projects to better share data and metadata on datasets, and include the establishment of a WLE Open Access tool using Dataverse to aggregate and harvest key datasets from partner organizations. It is expected this will be ready for the start of Phase 2 in January 2017.

As part of its plan to improve decision analysis on sustainable intensification, WLE will also link partners' key datasets and databases to a solutions platform.

In Phase 2, IWMI staff responsible for OA/OD and the WLE KMC coordinator will oversee implementation of the WLE OA/OD plan. A working group will be established with key data managers at each of the partner centers to help oversee the implementation of the plan.

1.0.14 Communication strategy

Knowledge management and communications (KMC) comprise a set of interlinked disciplines that include information management, behavior change communications, engagement, and uptake. These are essential to facilitate research moving along the impact pathway from outputs (e.g. journal articles) to changes in knowledge, attitudes and practices (e.g. changes in policies), to large-scale impacts. WLE's KMC strategy is described in Annex 3.10.

In Phase 2, WLE will strongly align its KMC to the overall WLE theory of change and impact pathway. It will focus on reaching out and engaging with decision makers in order to create widespread change through policy and incentive frameworks. WLE has also developed engagement strategies at the global and regional levels, and has established its flagship product, the WLE Thrive blog, which has been successful in promoting debate and discussion around key issues tackled by WLE's flagships.

KMC's core functions will include: 1) **showcasing WLE evidence-based research** results and making these broadly accessible to core target groups; 2) **strategic communication** to support efforts to communicate about the program, such as improving messaging to scale out results, and engaging with investors and decision makers; 3) **social learning and knowledge management** to strengthen learning and integration across the program; and 4) **engagement**, which is intended to support flagships and projects to target research users.

Experience from Phase 1 shows that when KMC staff are embedded in, or working closely with, flagships, outreach and uptake efforts are more successful. It is expected there will be one program-level staff member responsible for KMC. He/she will be part of the WLE Operations Team and will also work closely with the IWMI Information and Knowledge Group. As in Phase 1, a network of KMC staff from the centers will support Flagships to develop and implement communication and engagement plans for their flagships.

1.0.15 Risk management

This section focuses on the potential risks to the program and its performance, and how WLE proposes to limit, manage and mitigate against these. The section addresses both the risk management system, and the actual or potential risks during the period 2017-2022.

Defining and managing risk

WLE considers risks in four primary categories: 1) delivery; 2) financing; 3) governance, fiduciary and management; and 4) reputational (*Box 1.1*). All risks are identified, categorized and assessed in the lead center's risk register against probability and impact on a three-point scale (high/medium/low). These are reviewed by WLE management on a monthly basis, with mitigating measures identified by the risk owners and the trend of the level of risk from the previous assessment. New risks are identified and categorized, and old risks drop out when no longer considered a threat.

While risk management is devolved under Program Participant Agreements (in line with the CGIAR Good Governance Framework), risk registers will be shared between all the tier one centers so that risks pertinent to WLE are aggregated by the lead center and mitigating actions monitored. For partners external to the CGIAR system, fiduciary risk assessments are carried out prior to the disbursal of funds, reviewing systems and practices to ensure value for money.

The WLE Management Committee consolidates the risk register for the program, based on input from flagship leaders and center focal points. The Steering Committee endorses the risk management plan which outlines the actions from the risk register, and the lead center board (as the institution with financial accountability) provides oversight and final approval. Partner centers (and their boards) manage risk for their projects in parallel, and feed high risk items into the program register.

Box 1.1. Defining Risk

WLE divides risks into four primary categories: delivery; financing; governance, fiduciary and management; and reputational, as follows:

- Delivery risk is that project and program outcomes and outputs are not achieved for a variety of reasons, both internal and external.
- Financing risks involve unanticipated reductions in income, especially after implementation commitments have been made, and failure to attract financial support.
- Governance and management risks relate to the challenges of working across with a wide range of independent partners and projects. Fiduciary risk is that funds are not used for their intended purpose, do not achieve value for money, and/or are not properly accounted for.
- Reputational risk includes crosscutting risks not being fully addressed, that certain groups oppose the projects, or for example, a scandal involving a project partner.

There are two dimensions of assessment of these risks: the probability or likelihood of these occurring and the impact if they did occur.

Actual or potential risks during WLE Phase II

Based on the experience of phase I, including the evaluation conducted by IEA, the key projected risks have been identified and categorized, with an overall projected risk rating of *moderate* (*Box 1.2*). The projected delivery risks are, in many cases, surmountable by improved planning, budget allocations and careful oversight around data and implementation quality. Similarly, the governance and management risks can be avoided or reduced by careful planning and management. The harder risks to manage are fiduciary, where the high risks regarding funding and spending have been highlighted based on the experience of the uncertainty and instability during the latter part of Phase I. In addition, risks around fraud have been included in the register, particularly working with and through external partners, and actions taken around establishing clear financial authorization limits, monthly preparation and review of bank reconciliations, etc.

The primary mitigating measures include working across CGIAR to establish clear rules and procedures for performance-based allocations, ensuring transparency in financial projections for W1-2 funding, and working closely with donors. Contingent effects spill over onto delivery, relating to the impact of reduced funding on staffing levels and capacities. WLE's lead center and other tier one centers are stepping up bilateral fund-raising, and refreshing their overall corporate strategies to ensure that they retain and attract the best talent.

Reputational risks are harder to gauge, as they often relate to unforeseen acts. They are, in part, covered where delivery and fiduciary issues are addressed, but WLE will continue to engage with its stakeholders on the perception of the program, and will use its communications work to advocate on the cases and good practices.

Box 1.2. Risk Rating for WLE Phase II

Overall Risk : Moderate			
CATEGORY			
1. Delivery and Performance Risk	**2. Financial Risk**	**3. Governance, Oversight, Fiduciary and Management Risk**	**4. Reputational Risk**
1.1 Delay in programming	2.1 Uncertainity and instability of funding	3.1 Inadequate partner oversight	4.1 Not addressing gender, climate change and other similar cross cutting issues
1.2 Results not as per planned expectation	2.2 Poor financial and operational efficiency	3.2 Inadequate partner reporting and compliance	4.2 Opposition by the government, civil society or faith groups
1.3 Inadequate M&E and data quality	2.3 Over-expenditure due to various Internal and external factors including unexpected currency loss and hyperinflation, which leads to reduction of available funds	3.3 Fraud, corruption, or theft of funds	4.3 Issues with a project partner attracting negative media response
1.4 Not achieving research outcome		3.4 Inadequate agency-level governance due to high turnover, political instability, competency or knowledge	
1.5 Low quality of research outputs	2.5 Poor financial reporting		
Red = High Risk, Yellow = Moderate Risk, Green = Low Risk			

1.1 Budget narrative summary

1.1.1 General information

CRP Lead Center: IWMI

1.1.2 Summary

Table 1.4 Total Flagship and PMU Budget by Year

Flagship Name	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
FP1-Restoring Degraded Landscapes (RDL)	11,645,378	12,227,647	12,839,029	14,010,181	15,292,810	16,697,782	82,712,826
FP2-Land and Water Solutions for Sustainable Intensification (LWS)	10,447,856	10,970,249	11,518,762	12,569,520	13,720,298	14,980,846	74,207,531
FP3-Sustaining Rural-Urban Linkages (RUL)	6,303,054	6,618,207	6,949,117	7,583,223	8,277,699	9,038,431	44,769,732
FP4-Managing Resource Variability, Risks and Competing Uses for Increasing Resilience (VCR)	9,218,632	9,679,564	10,163,542	11,090,669	12,106,048	13,218,280	65,476,736
FP5-Enhancing Sustainability across Agricultural Systems (ESA)	10,765,677	11,303,961	11,869,159	12,957,997	14,150,814	15,457,765	76,505,373
Management & Support Cost	1,619,440	1,700,372	1,785,391	1,874,660	1,968,393	2,066,812	11,015,068
Strategic Competitive Research Grant	0	0	0	0	0	0	0
	50,000,038	52,500,000	55,125,000	60,086,250	65,516,062	71,459,915	354,687,266

WLE's resources are focused on providing major contributions toward achieving the CGIAR's System Level Outcome (SLOs), and Intermediate Development Outcomes (IDOs). Over the planned 6-year second phase, WLE will allocate USD 85 million towards meetings 21% of the SLO 1.1 target, ensuring 100 million more farm households have adopted improved varieties, breeds or trees, and/or improved management practices. WLE will allocate USD 47 million towards meeting 19% of the SLO 1.2 target, which is the 30 million people who are assisted to exit poverty, of which 50% are women. Under SLO 3.1, WLE intends to invest USD 137 million towards achieving a 5% increase in water- and nutrient (inorganic, biological)-use efficiency in agro-ecosystems, including through recycling and reuse across 24 Mha of land worldwide. WLE will invest USD 26 million to contribute to 5% of the CGIAR target for SLO 3.2 of 0.2 Gt CO_2-e yr^{-1}reduction of agriculturally-related greenhouse gas emissions. USD 38 million will pay for the research contribution to the restoration of 7.6 Mha of degraded land, 14% of the SLO 3.3 of ensuring 55 Mha of degraded land area are restored. As an example, WLE's investment in the five integration countries of India, Bangladesh, Ethiopia, Tanzania and Ghana will make significant contributions, with over 17 million farm households adopting improved management practices across these countries, and a 5% increase in water- and nutrient-use efficiency in agro-ecosystems across more than 16 Mha.

In Phase 2, WLE is comprised of five flagships (RDL, LWS, RUL, VCR and ESA), with the first four being largely thematic and the fifth being an integrating flagship. In coordination with the relevant thematic flagships, ESA collaborates with specific AFS CRPs and national partners in CGIAR target countries and with other selected countries in Asia and Africa. Gender and Inclusive Development (GID) is a core theme of WLE, with gender-specific work embedded in Clusters of Activities (CoAs) throughout each flagship, building upon the comprehensive Gender Strategy developed during Phase 1. Collectively, at least 10% of WLE's resources will be used for implementation of the strategy and to achieve gender-related targets. Please refer to the flagship budget narratives for more information on the key activities planned for each project.

WLE will maintain a strong network of partnerships at all scales, and non-CGIAR project collaborators will receive approximately 23% of the total budget. 34% of total funding from all sources will be used to support project staff costs of partner centers. Operational costs include travel at 7% of the total budget, and supplies and services at 22% of the budget. About 3% of the Program's budgeted expenditure will be incurred for Management and Support (PMU) costs and will be funded from W1&2 resources.

As agreed in the CGIAR Portfolio meeting in Rome in November 2015, the WLE Phase 2 budget is determined to be USD 50 million (W1 and W2 USD 10 million, and bilateral USD 40 million) for 2017, and is expected to grow at an annual rate of 5% for W1/W2, 5% for 2018 and 2019, and 10% for the remaining three years in case of bilateral grants. The total Program budget is about USD 355 million (19% of which is W1/W2) over a period of six years for the second phase of the program. The uplift budget scenario is considered at 40% of the base budget amounting to USD 142 in total, which will be equally contributed by W1/W2 and bilateral resources.

The main constraint to efficient implementation of the expenditure plans outlined below is the limited knowledge available at this early stage of the funding landscape over the course of the next six years. The W1+W2 and bilateral funding summary *Table 1.4* above is based on the best estimates available. Based on experience, funding availability will almost certainly fluctuate compared to what is provided here, which will affect the progress towards achieving targets of the CRP. WLE is also putting in place a results-based management system, which will include performance-based funding allocation. The impact of this could be that the budget allocations by partner may change accordingly during the course of the program.

Due to the low assumption of W1/2 from the Rome meeting, the Program requires a relatively high proportion of bilateral and/or W3-funded activities that are closely aligned to the strategic direction of the respective flagship. Now that WLE has received a positive IEA review, and given the intensification of concern around NRM issues for future sustainability, we are expecting that other W2 donors will be attracted to the program. The responsibility for developing the bilateral activities and raising the necessary funds is shared across the Tier one and Tier two partner centers, as detailed in the draft WLE resources mobilization strategy, which is being coordinated across all partners. Concurrently, in coordination with Tier one partners, the Program will also focus on increasing the W2 resources available. Should the bilateral resources not emerge as forecast, and W2 not increase, the rate of scaling up of the Program will be adjusted accordingly.

1.1.3 CRP funding plan

Table 1.5 WLE CRP Funding Plan:

Funding Needed	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	10,000,038	10,500,000	11,025,000	11,576,249	12,155,062	12,762,814	68,019,165
W3	0	0	0	0	0	0	0
Bilateral	40,000,000	42,000,000	44,100,000	48,510,000	53,361,000	58,697,100	286,668,100
Other Sources	0	0	0	0	0	0	0
	50,000,038	52,500,000	55,125,000	60,086,249	65,516,062	71,459,914	354,687,263

Funding Secured	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2(Assumed Secured)	10,000,038	10,500,000	11,025,000	11,576,249	12,155,062	12,762,814	68,019,165
W3	0	0	0	0	0	0	0
Bilateral	12,563,649	5,278,951	2,323,613	45,886	0	0	20,212,100
Other Sources	0	0	0	0	0	0	0
	22,563,687	15,778,951	13,348,613	11,622,135	12,155,062	12,762,814	88,231,262

Funding Gap	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	0	0	0	0	0	0	0
W3	0	0	0	0	0	0	0
Bilateral	-27,436,350	-36,721,048	-41,776,386	-48,464,113	-53,361,000	-58,697,100	-266,455,999
Other Sources	0	0	0	0	0	0	0
	-27,436,350	-36,721,048	-41,776,386	-48,464,113	-53,361,000	-58,697,100	-266,455,997

With a planned total budget of USD 350 million over six years (2017-2022), the fund-raising strategy will be implemented around two pillars:

1. A collective effort is placed on raising W2 funding for the program, gradually moving from 20% to 30% of the budget (USD 16.5 million to USD 25 million annually) as WLE Phase 2 achieves impacts on the ground;

2. Approximately 80% of the funds will come from W3/bilateral funding, with a collective responsibility from the Tier 1 partners to secure such resources for the relevant area of research. This amounts to a total of approximately USD 40 million/year of W3 and bilateral resources. Emphasis will be placed on key issues addressed by the different WLE flagships and the geographical priorities detailed in the proposal.

All WLE partners will engage in fund-raising and will draw on their respective thematic and geographical strengths and expertise. As done during WLE Phase 1, W1-2 funding will be used to leverage strategic bilateral funding in different geographical locations. Such leverage can take the form of a donor supporting a project or set of activities, which complement ongoing WLE activities. It can also consist of finding opportunities, which enhance regional collaboration, capacity building and influence by looking at joint funding. In this context, emphasis will be placed on identifying regional funding opportunities from both traditional development agencies and new donors such as private foundations.

The vast majority of W3 and bilateral projects are executed within 2-3 year timelines. WLE partners have secured USD 12.5 million in bilateral funding for the first year of Phase 2, and a total USD 20 million for the 2017-2022 timeframe. WLE partners have already developed a USD 70 million pipeline of high probability bilateral projects primarily for 2017 and 2018. In its core budget, WLE anticipates receiving at least USD 68 million in W1&2 funding over the life of Phase 2, with annual funding starting at USD 10 million and increasing to USD 12.7 million by the 6th year of the program. WLE and its partners will raise the remaining unsecured resources through bilateral and W3 sponsors. In addition to the established pipeline, WLE intends to raise USD 193 million in bilateral funding for a total of at least USD 263 million. Fund-raising targets for WLE are high but achievable, and resource mobilization efforts for Phase 2 are well under way. The above does not include the uplift budget, which would result in further outcomes as detailed in the flagship narratives. The secured funding and the pipeline is expected to contribute mainly for the first three years of the Program, and a fresh pipeline will be developed by the resource mobilization efforts for the second half of Phase 2 of the program.

1.1.4 CRP management and support cost

WLE's Management and Support Cost consists of staffing and operational costs for the Program Management Unit (PMU). The PMU is divided into three components:

1. Management (costs include: Director, Manager and Program Support; Steering and Management Committees, Audit, Support for Intellectual Asset Management and Capacity Building).

2. Monitoring, Evaluation, Impact Assessment and Learning (costs include: M&E Manager, Program-level evaluations, Planning and Reporting system).
3. Knowledge Management and Communications and Open Access (KMC and OA) (costs include: KM and Partnerships Coordinator; publications and website; support staff for data curation and management, data repositories).

Table 1.6 CRP Level Management & Support Costs [9]

COST COMPONENT		AMOUNT BUDGETED						
		2017	2018	2019	2020	2021	2022	6-year Total
A. Basic components as were given in the guidance document	Subtotal:	**1,050,747**	**1,106,324**	**1,181,204**	**1,247,924**	**1,330,588**	**1,417,619**	**7,334,407**
A.1 Management fee (indirect costs) charged by the Lead Center to handle WLE Finance and Administrative matters (Finance, accounting, reporting, contracts management, legal, HR, IT).	Amount:	198,821	211,759	222,308	234,233	245,987	257,046	1,370,154
A.2 CRP Director, Program Management Unit (PMU) staff. Travel, Supplies & Services and other operational costs related to the PMU.	Amount:	495,876	535,628	556,985	608,716	624,070	656,793	3,478,069
A.3 Flagship leader and regional coordinators. [10]	Amount:	-	-	-	-	-	-	-
A.4 CRP Management Committee and related costs	Amount:	25,000	25,000	25,000	25,000	25,000	50,000	175,000
A.5 Independent Steering Committee (or Science Committee) and related costs	Amount:	75,000	75,000	100,000	100,000	100,000	100,000	550,000
A.6 Communication activity related specifically to CRP communication and webpage	Amount:	171,250	174,138	192,112	195,175	183,330	201,580	1,117,584
A.7 CRP internal audit by the CGIAR Internal Audit Unit, or its future equivalent in the new System governance structure	Amount:	34,800	34,800	34,800	34,800	52,200	52,200	243,600

[9] Management & Support Costs for WLE will be W1&2 funded.

[10] The costs of Flagship Leaders and Regional CRP staff are embedded in the relevant FPs.

COST COMPONENT		AMOUNT BUDGETED						
		2017	2018	2019	2020	2021	2022	6-year Total
A.8 CRP internal and external reviews (e.g. CCEEs and other evaluations and reviews), as well as impact assessments	Amount:	50,000	50,000	50,000	50,000	100,000	100,000	400,000
B. CRP-level cross-cutting components not mentioned in the guidance document	Subtotal:	**568,693**	**594,048**	**604,187**	**626,736**	**637,805**	**649,193**	**3,680,661**
B.1 CRP special events (e.g. CRP-wide program meetings)	Amount:	-	-	-	-	-	-	-
B.2 CRP leadership meetings (e.g. country coordinators, flagship leaders, cross-cutting coordinators)	Amount:	10,000	10,000	10,000	10,000	10,000	10,000	60,000
B.3 CRP M&E coordination and systems (not including external evaluations and impact assessments)	Amount:	299,491	317,367	322,894	339,080	345,215	351,521	1,975,568
B.4 CRP communications, open access, IP assets, KMIS (including Lead Centre staff budgeted as direct costs not allowed under A.8 above)	Amount:	204,250	210,138	213,112	216,175	219,330	222,580	1,285,584
B.5 CRP capdev coordination	Amount:	6,533	6,729	6,931	7,139	7,353	7,574	42,260
B.6 CRP gender and youth coordination[11]	Amount:	-	-	-	-	-	-	-
B.7 CRP site integration support	Amount:	48,418	49,814	51,250	54,341	55,907	57,518	186,567
B.8 Other: (specify)	Amount:	-	-	-	-	-	-	-

[11] The Cost of Gender and Youth coordination is embedded in each of the CRPs Flagships.

Staffing costs are based on individual staff members' annual full-time equivalent cost, including base salary and benefits, whereas operational costs are proportionately estimated based on Phase 1 expenditures and a smaller management team. In the earlier years of Phase 2, it is anticipated that the Program Director will be the only full-time senior staff member; other PMU members will be covered by WLE at 80% or less, which may increase as funding increases in later years. Specialist support, such as capacity development, IA and Open Access, will be provided by partner centers, whereby WLE supports a modest number of days for the relevant specialist each year. WLE does not plan to have a dedicated Finance and Administration team and will be paying a management fee in the form of overhead to the Lead Center to handle CRP finance and administrative matters (Finance, ICT, HR, contract management, legal, etc.). The Gender and Inclusive Development core theme leader is a member of the PMU, but the costs associated with the core theme and theme leader are embedded within flagship project budgets.

WLE will fund Program Management Costs through W1/W2 resources and emphasis has been placed on keeping these costs as low as possible, ranging from USD 1.6 million to USD 2 million per annum.

1.1.5 CRP financial management principles

The initial pre-proposal budgets for Phase 2 of WLE were developed based on consultation with internal and external partners, and as prioritized within the particular clusters and flagships, allowing for, among other things, an increased emphasis on soils, and rural urban linkages. Following the feedback from the ISPC and subsequent consolidation of flagships, the revised integrating flagship (ESA) was re-prioritized to focus on the sustainability indicators framework.

W1/W2 funding was prioritized within each of the flagships to focus on key areas of innovation, where WLE has a comparative advantage, as had been determined during the development of the pre-proposal and proposal. Planned activities and outcomes were initially prioritized during the pre-proposal stage and then further refined following feedback from the ISPC, the determination at the portfolio level of the overall budget envelopes described above, and the subsequent re-submission of the WLE pre-proposal. As the designs of the flagships and the overall program were finalized, further refinements were made to the prioritization of budgets within the flagships by the flagship leaders and across the program in consultation with partners. Three of the thematic flagships are of similar approximate magnitude, RDL (23%), LWS (21%) and VCR (18%), each focusing on making a major contribution to the CGIAR targets on land degradation, water efficiency and productivity, and reducing risks and increasing resilience, respectively. RUL (13%) will build on its highly successful Phase 1 research, particularly focused on the sustainability of the increasingly important peri-urban landscape. The ESA flagship (22%), which builds on the Phase 1 network of partners in the focal regions, is the primary vehicle for collaboration in CGIAR target countries, and integration of the relevant research activities with the AFS CRPs. As such, this flagship will focus on co-investments with the AFS CRPs to catalyze larger research and development activities in these countries.

In Phase 2, Flagship Leaders (FLs) will continue to review plans and progress of projects at several points throughout the year. Annual work plans will be reviewed by FLs who will have an opportunity to provide feedback, guidance and direction, and must be finally approved by the FL and Program Director for W1&2 funding to be secured. Progress will be reviewed through mid-year reporting, which is also an opportunity for the flagship leader to influence the direction of projects, and ensure they remain viable within the program. Annual reports will compare the progress of projects against targets set through the planning process, and will be used to determine if a project will continue to be funded, at what level, and influence plans for the following year.

Bilateral projects mapped to WLE must be well aligned with the objectives of the program and support achieving targets. Partners have agreed to bilateral fund-raising targets based on their W1&2 allocations. Resource mobilization by partners to support the program will be considered annually as part of the planning and budgeting process, and W1&2 funding adjusted based on performance.

To strengthen results-based management, FLs will be able to reallocate resources between projects and outputs twice during the Phase 2 program cycle, based on an open and transparent cumulative performance assessment mechanism. Up to 25% of a project's budget can be reallocated by the FLs to other, better performing, projects and/or outputs for years 3 and 4 (based on performance in the first year and a half) and for years 5 and 6 (based on aggregate performance in years 1-3). Depending on possible extenuating circumstances for non-delivery (type of project/impact trajectory timescale, natural disaster, political issues, etc.), the FL *may* recommend reallocating a proportion of funds from an underperforming output/project to one of the high-performing projects that has the potential to yield good results. Projects with some delays or issues reported will not be subject to fund reallocation, but will be reviewed and any remedial actions proposed and tracked. The effectiveness of this system requires not only the appropriate and transparent application of results measurement, but also clarity on the level of budget ownership with FLs in terms of tracking, reporting and revising (and hence the CoAs over which they have some influence), and the rules and expectations around annual variances for flagship and participating partner budgets.

1.1.6 Budgeted costs for certain key activities

Table 1.7 Estimated Average Annual Costs for Key Activities

	Estimate annual average cost (USD)
Gender	6,000,000
Youth	3,000,000
Capacity development	7,100,000
Impact assessment	900,000
Intellectual asset management	1,160,000
Open access and data management	500,000
Communication	3,000,000

1.1.7 Other

The indirect costs in this budget include costs for the support service units such as HR, Finance, Administration, etc. In case there is a sudden decrease in funding, indirect costs will remain at a higher rate, as it will take time to make adjustments. The indirect cost rate is based on CGIAR Financial Guidelines Series No. 5 on cost allocation guidelines.

The highest risks are instability of funding and increase in costs due to change in external and internal environment. The Program team, under the leadership of the lead center, will be reviewing the risks on a quarterly basis and ensure that budgetary adjustments are tracked due to these risks.

The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the bilateral projects mentioned in this budget will be approved without any variance. External partnerships, which are one of the most important components in the proposal, are

mainly budgeted under bilateral projects and, to some degree, this form of funding minimizes risk arising from the fluctuations in windows funding.

Inflation is considered in the costs at 2.63%, which is based on the average IMF projections for the next six years. The major costs are incurred in USD whereas the revenue is generated in various currencies, including, and not limited to, EUR, AUD, GBP, etc. This may expose the Program to the risk of currency fluctuation, which needs to be monitored closely and may be reduced by subcontracting the partners in the contract currency.

2 Flagship Projects

2.1 WLE Flagship 1: Restoring Degraded Landscapes (RDL)[12]

Lead Centers: CIAT & ICRAF
Partner Centers: Bioversity, CIFOR, CIP, IFPRI

2.1.1 Flagship Narrative

2.1.1.1 Rationale and scope

The RDL Flagship will support governments and people to restore their degraded landscapes, enhancing ecosystem services and contributing to vibrant agroecosystems, and the benefits they provide: food, energy, clean water, income and livelihoods. The rapid degradation of soils, water and biodiversity in agricultural landscapes seriously compromises ecosystem services and reduces the resilience of food systems and livelihoods (MEA 2005; Balvanera et al. 2016)[13].

Everyone is aware of the challenging numbers: 20-25% of global land area is estimated to be degraded, 100 million hectares (Mha) are severely degraded by erosion, deforestation, excessive fertilizer use, waterlogging, salinization, and acidification and nutrient extraction (ELD Initiative 2015). Prevention of degradation by reducing and reversing degradation risks on the remaining 75-80% of land is equally important, but little considered. Land degradation impacts the health and livelihoods of 1.5 billion people (FAO 2011), often disproportionally affecting women and the poor; according to one estimate, 65% of the agricultural land in sub-Saharan Africa is degraded (Vlek et al. 2008), costing USD 68 billion per year, and reducing agricultural GDP by 3% (Zingore et al. 2015). Without preventive action, billions more may be affected over the next few decades.

There is growing political momentum for large-scale commitments to prevent land degradation, and to restore or regenerate degraded natural resources and ecosystem services, representing an unprecedented change in national and global agendas, and with it a unique opportunity for research to influence policy and action. Global recognition is evident in the proposed Sustainable Development Goals (SDGs) on restoring soils for sustainable agriculture (SDG 2), combating climate change (SDG 13), and halting and reversing land degradation, halting loss of biodiversity, and maintaining terrestrial ecosystems (SDG 15).

The United Nations Convention to Combat Desertification (UNCCD) at COP12 in October 2015 adopted the land degradation neutrality (LDN) target, and have proposed a new 'LDN Fund'. At the UNFCCC COP21 in Paris in 2015, the French government launched the "4 per 1000" initiative, to increase global soil carbon stocks as a climate change mitigation and food security strategy; 140 ministries and organizations have already signed. The African Forest Landscape Restoration Initiative (AFR100) is a new country-led effort to restore 100 Mha of land; 10 countries have already committed 32 Mha. Initiative 20x20, launched in 2014, is a country-led effort to begin restoration on 20 Mha of land in Latin America and the Caribbean. Eleven countries, more than 25 Mha and USD 850 million have already been pledged.

The World Bank, GIZ, World Resources Institute, and the International Union for Conservation of Nature support a number of these initiatives. National initiatives include the Sustainable Land Management Program of Ethiopia, budgeted at USD 7.5 billion, and the German program 'Soil Rehabilitation for Food

[12] All acronyms are defined when first used and then summarized in Annex 3.14.
[13] All references are listed in Annex 3.15.

Security', a EUR 40 million investment in restoring degraded soils in Kenya, Ethiopia, Benin, Burkina Faso and India.

Political will, country-level planning, and financial instruments are important and necessary, but not sufficient conditions for landscape restoration and preventing degradation. Investments will have minor impacts – and yield little return – unless interventions are effective and viable for local land managers, who are often women in smallholder farming systems. Pledged funding may be difficult to mobilize unless both private investors and public budget-holders are convinced about the gains that restoration yields. Also, despite favorable national and global policy frameworks, implementation is often stifled by unfavorable local political, institutional, economic and social environments (Cordingley et al 2016). Initiatives such as the World Bank *Inclusive Green Growth* strategy and the OECD discussion on Green Growth recognize a lack of economic alternatives as a major challenge to sustainable land management. So, while momentum is growing to invest in restoration, clarity on intervention strategies in local contexts is often lacking (Shepherd et al. 2015a). We aim to change this situation by providing evidence on the costs and benefits of alternative strategies, and the incentives and enabling conditions required for their success. With the increased evidence that shared prosperity (Piketty and Saez 2014) is vital for sustained development, RDL will explore the linkages among equitable access, decision making and restoration.

RDL will thus address the gaps between aspirational targets and local realities. We will work with investors to demonstrate how landscape and soil restoration efforts can, in practice, provide optimal benefits according to the aspirations of multiple stakeholders, especially women; and how to cost-effectively set up systems for targeting, monitoring and learning. Institutional issues, such as how to protect the land rights of smallholders under large-scale initiatives, will also be addressed. RDL will support a stable and conducive environment for private sector investment in restoration.

RDL will work with initiatives in six countries, Kenya, Ethiopia, Tanzania, Ghana, Colombia and Peru, to accelerate progress towards successful implementation of restoration agendas. These include CGIAR integration countries and countries of our partner initiatives, the GIZ Soil Rehabilitation Program, and Initiative 20by20. These countries are also where the '4 per 1000' and the 'AFR100' are likely to land on the ground. Other countries will be included in systematic reviews and syntheses to inform regional and global debates and processes. RDL will focus on integrated landscape approaches that include restoring agriculture and agroforestry, and integrating sustainable forest, wetland and livestock management into production systems and practices that regenerate soils, water and other ecosystem services.

2.1.1.2 Objectives and targets

The RDL Flagship will contribute to achieving the ambitious goals of the CGIAR's Strategy and Results Framework (SRF) to regenerate degraded lands. RDL responds to four of the CGIAR Grand Challenges: soil degradation (especially on farmed lands); degraded water supplies (primarily by sedimentation and hydrological changes); competition for land and water (often intensified within large investment frameworks); and climate change (both as a victim and contributor). It will contribute primarily to the CGIAR System-Level Outcome (SLO) on improved natural resource systems and ecosystem services, and associated IDOs. *Table 2.1.1* shows the contribution of RDL to the SRF targets and main sub-IDOs.

To harness the opportunities created by the new integrated portfolio of CGIAR, RDL will co-invest in restoration with flagships of CGIAR Research Programs having related mandates: FTA's Flagship Project (FP) on forest landscapes, DCL's FPs on dryland livelihoods, climate change and degradation, Livestock's FP on livestock and environment, and CCAFS's FP on climate change mitigation. It will further facilitate CGIAR engagement in global restoration dialogues, through the Global Landscapes Forum (GLF), the Land Degradation Assessment of the Intergovernmental Platform on Biodiversity and Ecosystem Services

(IPBES), the Convention on Biological Diversity (CBD), the Global Partnership on Forest Landscape Restoration (GPFLR), the Global Soil Forum, the Economics of Land Degradation Initiative (ELD), and the UNCCD.

Major land degradation processes to be tackled by RDL include: decline in soil productivity due to soil erosion, nutrient depletion, biodiversity and carbon loss; declining water quality through sedimentation and runoff; and the impact of above- and below-ground biodiversity and biomass loss on ecosystem services. Addressing these biophysical processes requires changing the institutional and socioeconomic environment to make action possible, and including women and men in developing solutions. To do so requires close attention to the underlying drivers and multiple perceptions of degradation. These drivers and perceptions affect the landscapes and livelihoods of land users. Without addressing them, successful restoration remains unlikely.

Table 2.1.1 CGIAR Targets, IDOs and RDL Flagship Outcomes and Contributions

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	2022 Targets	Budget (USD '000)
1.1	SLO 3; sub-IDO 3.1.1 Land, water and forest degradation minimized; sub-IDO 3.1.3 Increased genetic diversity of agricultural and associated landscapes; sub-IDO 3.3.1 Increased resilience of agro-ecosystems and communities B1.1: Gender-equitable control of productive assets and resources (SDGs 2, 13, 15)	Ethiopia, Kenya, Tanzania, Ghana, Peru, Colombia	Governments, agencies, and local stakeholders invest in research-based strategies and programs in three countries targeting adoption of restorative and preventative practices* that enhance ecosystem services	Adoption of improved practices by 1.5 million farm households, resulting in 3 Mha with restorative, preventative and climate-relevant practices, with a 5% increase in water- and nutrient-use efficiency in restored lands, and 4 MT CO_2-e yr^{-1}sequestered in soils	33,000
1.2	SLO 3 sub-IDO 3.1.1 Land, water and forest degradation minimized; sub-IDOs 3.3.3 and A1.1 Reduced net greenhouse gas emissions from agriculture, forests and other forms of land use C1.3: Conducive agricultural and environmental policy environment	Ethiopia, Kenya, Tanzania, Ghana, Peru, Colombia	Climate financing, national strategies and programs invest in research-based practices* to build soil fertility and soil carbon in three countries, providing food security, adaptation and mitigation benefits	Adoption of improved practices by 1.5 million farm households, resulting in 3 Mha with restorative, preventative and climate-relevant practices, with a 5% increase in water- and nutrient-use efficiency in restored lands and 4 MT CO_2-e yr^{-1}sequestered in soils	33,000

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	2022 Targets	Budget (USD '000)
1.3	Sub-IDO IDO 3.1.1 Land, water and forest degradation minimized D 1.1: Enhanced institutional capacity in partner organizations	Ethiopia, Kenya, Tanzania, Ghana, Peru, Colombia	Capacity of national partners enhanced, leading to national, district, and regional agencies in six countries adopting recommended monitoring and verification frameworks	100 trained professionals applying RDL methods for targeting restoration options, risk assessment, and monitoring and evaluating impacts in six countries.	17,000

** Restorative, regenerative and climate-relevant practices include sustainable land management, terracing, forage grass strips, and tree planting combined with soil fertility management; increasing landscape and agro-biodiversity; integrated management of agrosilvopastoral landscapes; improved forages and livestock management for restoration of grassland and pasture; slash and mulch agriculture in secondary forests; evergreen agriculture; agro-ecological intensification; and organic matter management, waste recycling and conservation agriculture.*

Our research questions align well with priority research questions identified by a rigorous collaborative process of scientists and policymakers to identify priority research questions for soil and biodiversity for ecosystem service science in the twenty-first century (Adewopo et al. 2014; Naeem et al. 2015).

RDL's uplift scenario calls for USD33.6 million for one extra outcome (outcome 1.4, expansion of the program of work into four additional countries in Asia and Africa). This would be used to expand intensive engagement into four additional countries, including in Asia, and engage with an additional research consortium on soil biology and soil health under CoA 1.2, in which fundamental research on soil microbiology and the links to nutrition would be explored. The uplift scenario would, therefore, increase our target countries to 10, and increase our targeted adoption to 4.2 million households and 8.5 Mha with preventative, restorative and climate-relevant practices. Although gender work is already integrated, an uplift scenario will also significantly expand this area of work.

2.1.1.3 Impact pathway and theory of change

RDL does not assume that good research automatically results in outcomes and impact. Instead, we work with partners who are already committed to restoration, and together develop the evidence, tools and capacity needed to enable successful investment and implementation of restoration agendas. Thus, RDL will support evidenced-based decision making at multiple levels for public sector investments, and a stable and conducive environment for private sector investments in restoration.

RDL is aligned with the four types of outcomes (changes) of WLE's impact pathway: 1) policies catalyzing change; 2) investments supporting change; 3) awareness of the need for change; and 4) adoption of solutions (*Figure 2.1.1*). Achieving impact is not linear and the systems in which we work are complex, having multiple linkages and vested interests. Therefore, RDL sees partners and stakeholders as participants in a dynamic social learning process of innovation. Key to success in priority countries will be identifying and promoting incentive systems and enabling environments to achieve large areas of adoption of restorative agricultural and landscape management practices.

The RDL ToC has the following general assumptions (as detailed in the WLE overview):

1. Interventions must be responsive to the agro-ecosystem, socioeconomics, gender and political landscapes in which they operate.
2. Managing complex trade-offs, and changes in policies, plans and finance mechanisms requires early and continuous dialogue and supportive institutions.
3. Major changes in behavior are needed to transition to sustainable intensification of agriculture.

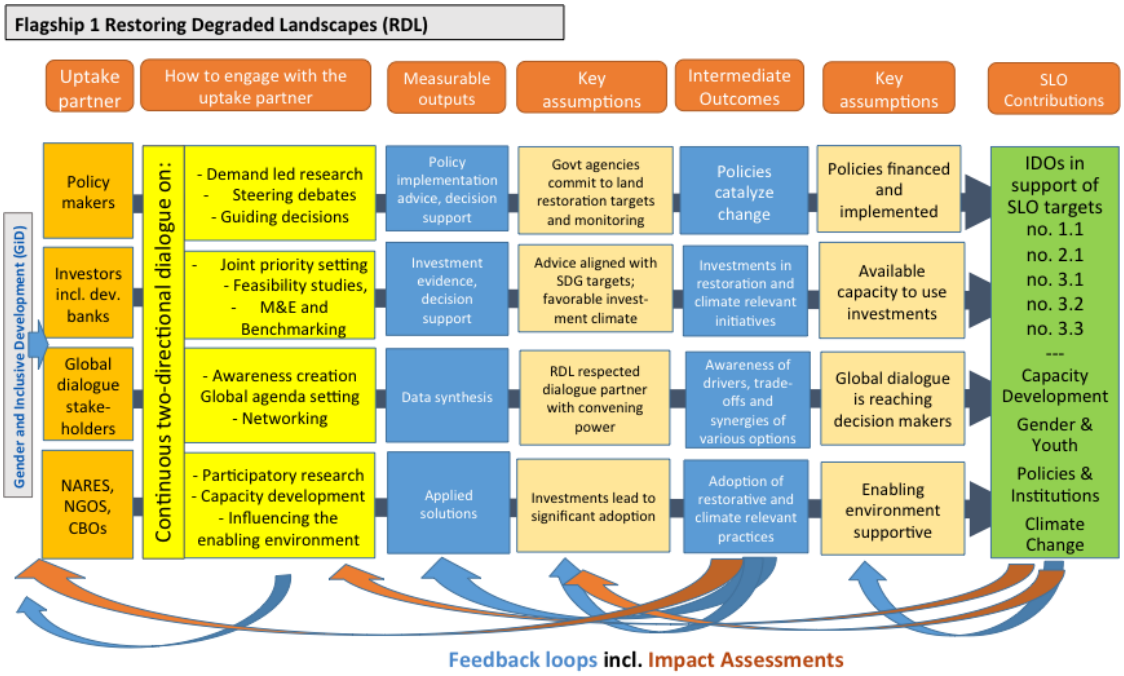


Figure 2.1.1 RDL's Impact Pathway

In addition, the RDL Flagship adds the following specific assumptions:

1. **Policies**: A plethora of policies, conventions and initiatives exist. *RDL's assumption is that the new investment commitments provide a unique opportunity to catalyze the needed change and achieve restoration of degraded lands*. RDL will develop knowledge and strengthen capacity for implementation of land restoration policies. Success will, in part, be based on identifying and addressing constraints and incentives to implementation.
2. **Investments**: RDL focuses strongly on supporting the restoration agenda by capitalizing on and catalyzing investments. *Our assumption is that investors will be convinced by the evidence on the costs and social returns of promising restoration pathways to continue to make new investments.* RDL will work with major bilateral and multilateral agencies and banks, and relevant national bodies (public and private) to develop evidence, success stories and relevant investment opportunities.
3. **Awareness**: While global awareness of land degradation is high, awareness of the benefits of integrated landscape approaches and cost-effective strategies to achieve it is not. *Our assumption is that dialogue around research results can influence opinions, policies and strategies*. RDL will engage in national and global dialogues making stakeholder differences transparent to facilitate agencies to identify and manage trade-offs and synergies in landscapes.
4. **Uptake:** Adoption of restorative solutions is the long-term goal of RDL. *Our assumption is that increased investment, guided by strengthened institutional capacities and robust analysis to identify*

incentives and enabling conditions, can result in sustained adoption of restorative practices with benefits to local people and off-site communities.

The WLE theory of change suggests that to generate these outcomes from research, requires the following mechanisms: evidence, solutions, changed perspectives, and action:

Evidence: With partners, RDL will develop evidence, both *ex ante* and *ex post*, on the costs and value (monetary and non-monetary) of land/soil/biodiversity protection and restoration investments to society, including for water supplies and climate change mitigation. Analysis of land users' perceptions of degradation, decision making and possible incentives to change behavior, trade-offs and synergies amongst various interests will be the basis for promising prevention and restoration pathways. Building an evidence base around gendered trade-offs and power barriers to land access, carbon sequestration in tropical soils, and how soil carbon contributes to livelihoods and ecosystem services will be important elements.

Solutions: RDL solutions will combine locally appropriate portfolios of preventive and restorative interventions with institutional and policy changes appropriate for various public and private sector actors (governments, public-private partnerships [PPPs], Water Funds), World Bank, GIZ, Green Climate Fund). RDL will promote sustainable interventions in restoration through the removal or reduction of barriers and risks that have generally limited more private sector investment in restoration. Analysis of the political-economic context will help to ensure smallholders and, in particular, women are not marginalized.

Changed perspectives: RDL will engage with multi-sector actors through national, regional and global dialogues using innovative learning approaches to foster investments in mutually agreed solutions. While the country level is a strong focus, RDL will also facilitate CGIAR engagement in global dialogues (see Section 2.1.1.2). WLE invested considerably in this during phase 1 through various events and conferences, and in dialogues on its blog (*Thrive*), and as a result it is a recognized convener on restoration issues for CGIAR.

Action: RDL research supporting action includes all the above and also capacity development to support changes that address complex trade-offs and reduce social, economic and gender inequity, while enhancing natural resource systems and ecosystem services. We recognize that there are strong vested interests and other considerations that affect decision making by policymakers. Therefore, we will monitor progress along our impact pathway, learn from experience, and adapt as needed.

2.1.1.4 Science quality

Science quality is at the heart of CGIAR, and will be monitored as far as possible via performance of the program and its partners in terms of: 1) capacity and track record in research; 2) publication performance (citation index); 3) stakeholder recognition; and most importantly; 4) progress towards outcomes and impacts. Output quality monitoring is an obligation of participating research partners and the program, based on quality control mechanisms; RDL will ensure quality of science through implementation of the WLE Results-based Management (RBM) strategy.

The quality of science and leadership of the RDL Flagship predecessor in Phase 1 of WLE was evaluated in 2015/2016 (IEA 2016). The evaluation found that "project leads have appropriate expertise and capability," and "flagship leadership had excellent credentials in soils ensuring … the soils research agenda within WLE will be rigorous." Based on interviews, field visits and assessment of proposals to bilateral donors, IEA found the methodologies to be sound, and have an appropriate level of domain integration. These strengths from Phase 1 will be taken forward into Phase 2.

An important observation from the IEA evaluation provided guidance to the design of the RDL Flagship as proposed for Phase 2. IEA found that, while RDE had a few good to excellent publications well-placed in high-quality journals and accounted for the majority of the most highly cited publications in WLE, there was sometimes a tendency to "oversimplify problems and make claims about approaches to ecosystem service management that are insufficiently substantiated." This is an often heard criticism of ecosystem service approaches (Naeem et al. 2015). In response, RDL will be more strongly focused on substantiating ecosystem service approaches and systematic reviews as part of generating evidence aligned with the ToC.

Past and ongoing work of the Flagship and its partners that will be brought to bear on addressing the challenge of restoring degraded lands is myriad. WLE center partners have developed a wide range of technologies for restoring degraded lands during decades of research on crop, soil, biodiversity, land and forest management in every region of the developing world. This knowledge will be used to build investment portfolios, with a high priority now placed on overcoming barriers to adoption and implementation. Restorative farming systems incorporate crop rotations, conservation agriculture, agro-ecological principles, and integration of trees, grasses and forest in production landscapes. Semi-natural agrosilvopastoral systems have significant restorative potential in a range of agro-ecologies. In an extensive review, it was demonstrated that resource-conserving agriculture (e.g. integrated pest management, conservation agriculture, agroforestry, aquaculture, water harvesting) increased productivity while also improving the supply of critical environmental services (Pretty et al. 2006). The Comprehensive Assessment of Water Management in Agriculture further laid out the evidence supporting restoration of degraded land as a key entry point to achieve enhanced water-related ecosystem services in landscapes (Bossio et al. 2007, 2008, 2010).

The global assessment of economics of land degradation (ELD) conducted an analysis of policies, market incentives and rural services that enhance the adoption of sustainable land management (SLM) practices (Nkonya et al. 2011; Nkonya et al. 2016). Because global assessments are not sufficient to support decision makers at sub-national or local level, a framework was developed in Phase 1 to operationalize ELD concepts at farm and landscape levels (Emerton 2014). This stepwise framework is used to: 1) describe the local conditions and contexts that enable or constrain farmers' land management options and choices disaggregated by gender and social groups; 2) trace through the wider effects of local land management choices on other sectors and groups in the broader landscape using participatory ecosystem services mapping, models and valuation tools; and 3) identify needs, opportunities and mechanisms to put in place the conditions that would better encourage, empower and sustain restoration. These tools have been successfully applied in pilot cases in Phase I, and will be applied more widely in Phase 2 by incorporating an additional component on risk analysis.

Similarly, flagship partners have pioneered and developed frameworks and tools for landscape management of ecosystem services. RDL scientists and partners have set a clear definition of six principles and guidelines for getting the science right for payments for ecosystem services (PES) schemes (Naeem et al. 2015). They have engaged with partners in the conservation, development, and agricultural domains to develop ecosystem service models that facilitate the trade-off analysis between restoration actions and multiple ecosystem services and yield; and which further articulate these outcomes as measures of human well-being (Wood and DeClerck 2015). Phase I of RDL has strengthened action research on the ground with development partners, testing the impacts of large-scale soil restoration actions on water quality and energy production (Estrada-Carmona and DeClerck 2012) that will continue in Phase 2.

WLE partner centers have advanced the understanding of soil carbon dynamics as they relate to mitigation (Sommer and Bossio 2014; Vågen and Winowiecki 2013; Fonte et al. 2010), building on the foundation of the Tropical Soil Biology and Fertility (TSBF) Institute (Barrios 2007). In Phase 1, the work

of TSBF was extended into the climate change arena (Sommer et al. 2015), demonstrating trade-offs between soil fertility management and greenhouse gas emissions. The CGIAR has also been an innovator of new methods for large area soil health monitoring using spectral approaches and remote sensing (Shepherd and Walsh 2007; Vågen et al. 2015; AfSIS 2016), with new approaches to quantifying soil health impacts using risk-return decision models (Shepherd et al. 2015b) to ensure data collection efforts directly address stakeholders' decision dilemmas. The CGIAR has a clear advantage in soil science, with strong capacity, many partners, and laboratory facilities in the tropics unique in the regions where we work.

In Phase 1 CRPs, there has been significant progress towards the development of concepts and methods for reliable quantification of the risks and extent of land degradation (Shepherd et al. 2015a; Vågen et al. 2015), which will be used to prioritize interventions for prevention of land degradation. This includes the Land Degradation Surveillance Framework developed by the CGIAR and the Africa Soil Information Service (Shepherd et al. 2015a). The framework integrates systematic ground survey data, unmanned aerial vehicles (UAVs), soil analysis using spectral techniques (infrared, x-ray and laser), and remote sensing covariates with data mining and digital mapping techniques, and is already used widely by the CGIAR and AfSIS. It is being piloted by the World Bank Living Standard Measurement Study in Ethiopia and Uganda, and considered by the UNCCD LDN initiative. The framework includes indicators of vegetation cover and productivity, biodiversity, soil health and carbon, soil erosion, and hydrology. Integration of these types of frameworks into national- and sub-national-level planning processes will be an important area of work in Phase 2.

The scientific capacity of the Flagship is strong. The core team brings strong publications records and proven management experience (See Annex 3.7), indicating the team's capacity to assure the scientific quality and strategic research direction of RDL. The Flagship will continue to uphold the high standards of development-relevant scientific publishing, facilitated by continuous external reviews by the RDL leadership, the WLE steering committee, and other external experts and stakeholders.

2.1.1.5 Lessons learned and unintended consequences

Generating impact from research: In Phase 1, WLE researchers intensified their engagement with existing initiatives of public and private partners, based on the hypothesis that adoption of research in the context of ongoing initiatives would be more likely to achieve sustained impact. Two success cases were in Kenya and Peru. Working with government partners, WLE contributed to the formulation of a new law in Peru that legitimizes rewards for ecosystem service schemes. In Kenya, WLE provided research for an existing PPP, contributing to the development and launch of the first Water Fund in Africa. This partnership model, notable for creating impact (IEA 2016), will be intensified and taken forward.

Political economy and unintended consequences of investment. Examination of the impact of foreign investment in land in Africa has highlighted that, while land use is intensified and productivity increases, these gains are often accompanied by loss of access to resources by the local population (Bossio et al. 2012). Thus, RDL posits that political will, country-level planning and financial instruments are important and necessary, but not sufficient conditions for equitable restoration. RDL will strive to ensure inclusion of land users' rights into restoration schemes, and test options that will encourage and empower them to play active roles in restoration activities.

Gender is complex: Strengthening land rights for women is important, but not sufficient to improve livelihoods and ensure restoration efforts are equitable. Proposed restoration strategies must determine how they will affect men and women and the relations between them. In the Upper East Region of Ghana, Shea trees provide essential products for women's livelihoods. Removing trees in favor of increasing

annual crop production, a man's endeavor, is a common agricultural intensification strategy. This not only contributes to land degradation, but also jeopardizes a central livelihood strategy for women. RDL will continue to co-develop tools and parallel enhancement of national and sub-national institutional capacity to identify and factor power relations, differing perspectives, constraints and opportunities that contribute to gender-equitable outcomes into investment planning and implementation.

Landscape opportunities are often cross-sectoral: The World Bank supports an integrated approach to sustainably managing land and water resources for multiple purposes and functions -- a *landscape approach*. The World Bank sees that managing natural resources in an integrated way provides the basis for enhancing people's livelihoods, and offers an opportunity to plan across economic sectors. In WLE, this lesson is clear – to restore degraded landscapes, an effective entry point can be payments for ecosystem services (PES) - commonly clean water - of high value to sectors outside of agriculture. A lack of rigor in measuring and monitoring ecosystem services inhibits investment in landscapes (Naeem et al. 2015). Getting the science right for Water Funds, facilitated by The Nature Conservancy (TNC), is a growing opportunity to provide the scientific evidence needed to encourage investment in landscapes.

Different languages among investment, finance and research actors: At the Global Landscapes Forum in December 2015, Leslie L. Durschinger, Founder and Managing Director of the Terra Bella Fund, said "It takes time to legally set up a facility and make sure the flow of money would actually go where it needs to go on the ground, and you cannot invest until this infrastructure is in place." RDL research to assess ecosystem services, and evaluate costs and benefits of land management options (Emerton 2014) provides only part of the fundamentals necessary for a project to be 'investment ready'. Thus, RDL will work directly with various investors to tailor research to investment needs, including investors such as IFIs, governments and impact investors.

2.1.1.6 Clusters of Activity (CoA)

RDL builds on the experience, databases, tools and partnerships of Phase 1, and adds new research on soils and risk assessment and monitoring frameworks through three interlinked clusters of activity (CoA) as presented in *Figure 2.1.1.2.*

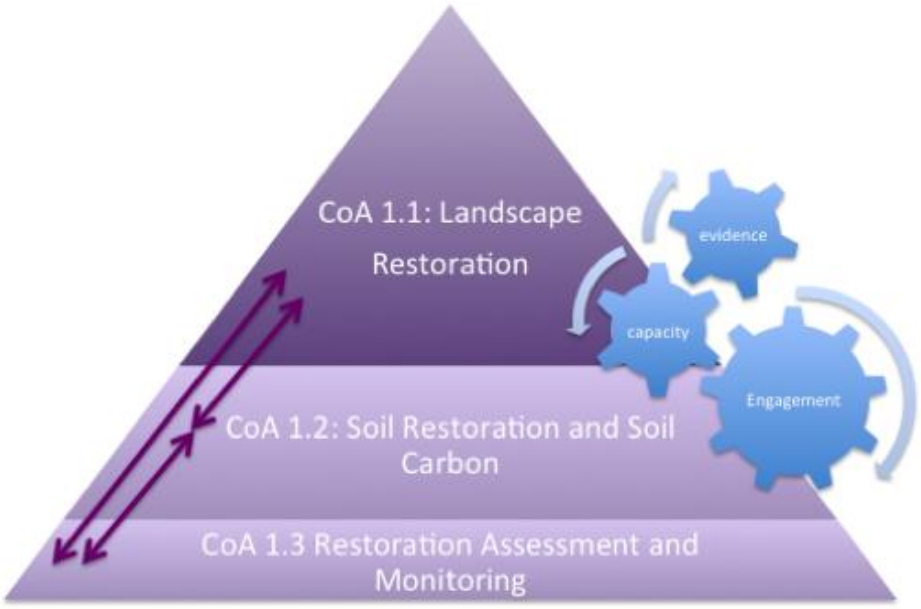


Figure 2.1.1.2. RDL Cluster of Activities

CoA 1.1 will develop evidence to target and catalyze investments in restoration initiatives and influence their implementation, emphasizing social, economic and political interventions coupled with ecological approaches. This CoA will address gender involvement in restoration. CoA 1.2 will undertake soils research needed to protect and restore soil resources and their ecological functions, focusing on soil carbon restoration for food and nutrition security, and climate change adaptation and mitigation. This work can stand alone as support for investment in soil restoration initiatives, and also provides the scientific underpinning on soils for CoA 1.1 and AFS CRPs. CoA 1.3 will develop and implement an integrating framework for the CGIAR and partners to prioritize preventive and restorative intervention strategies and monitor progress towards land restoration targets. It will help national agencies to develop monitoring systems that suit their conditions. It will also support CoAs 1.1 and 1.2, and strengthen institutional and future research capacity to target and monitor restoration.

Cluster of Activities 1.1 Landscape Restoration
Countries: **Ethiopia, Kenya**, **Tanzania**, **Ghana,** Burkina Faso**, Peru,** and **Colombia**

Description:
This CoA will deliver the evidence needed for investment in, and implementation of, restoration initiatives. It will focus on the importance of social, economic and political interventions coupled with the ecological approaches needed to restore and/or regenerate degraded landscapes, and balance trade-offs amongst various stakeholders, including trade-offs between livelihoods and environmental outcomes, and short- and long-term goals. It will build investment portfolios using the participatory tools developed in Phase I (Emerton 2014), and by our partners, for systematic evaluation of approaches and incentives for restoration, especially those that can empower women. Analysis will determine the range and quantity of ecosystem services enhanced, the social impacts of restoration, synergies and trade-offs, and build scenarios for structured decision making. The attributes and outcomes of national restoration programs will be comparatively assessed. This CoA will advance the science of ecosystem services applied to agricultural systems, and of political ecology and its application to solving problems of ongoing land degradation.

Research questions:
Which socially and economically viable farming practices contribute to the restoration and protection of land, soil, water and biodiversity? What species and biodiversity practices are locally relevant to meet restoration and food security needs? What bundles of ecosystem services can be enhanced through various restoration scenarios?

What incentives and enabling environments are required for widespread adoption of sustainable landscape restoration under different conditions? How can local business development generate financial means for local restoration measures and to divert pressures on degraded lands? How can land restoration initiatives be designed to benefit women and protect the rights of smallholders?

Theory of change and Impact pathway:
For this CoA, our partner initiatives are Initiative 20by20 in Latin America, AFR100, Tana Water Fund and the Volta Basin Authority (see Section 1.0.8). With these partners, we will work along the pathways of the RDL ToC: in dialogue with national policy implementers to develop evidence of risk, return and societal benefits of restoration to motivate investments; co-developing analysis and tools, and engage in dialogue with multi-sector stakeholders to increase awareness of the drivers, trade-offs and synergies of various preventative and restorative strategies that improve human well-being; and enhancing the capacity of national partners to align priorities from national to global levels, and to apply research-based evidence to improve planning, monitoring and evaluation. Working with TNC, replicating the success of the Tana Water Fund in other basins in Africa may be possible. Cooperation with knowledge partners,

such as WUR, will strengthen cooperation with OECD and UNDP in the area of inclusive green growth, creating local economic alternatives, and linking business innovation and restoration measures, as well as to share experiences in the execution of PPPs to tackle social, environmental and commercial ambitions in parallel.

Key outputs:

1. Synthesis of factors affecting success and failure of restoration initiatives (enabling factors and incentive schemes), leading to recommendations for the design of new restoration initiatives.
2. Evidence-based investment scenarios and value propositions for investments in socially equitable restoration, considering on-site and off-site costs, benefits and risks in terms of human well-being and ecosystem services, based on case studies and comparative assessment of national restoration programs.
3. Innovative restoration pilots that implement incentives and enabling conditions for adoption of sustainable and equitable restoration interventions.
4. Guidelines, databases, tools and indicators for planning, monitoring and evaluation of restoration initiatives considering multiple objectives developed with partners in case studies.
5. Knowledge products for AFR100, Initiative 20x20 and multi-stakeholder platforms, assessment of progress towards SDG15 of zero net land degradation, peer-reviewed scientific papers, videos, briefs, and blogs for the WLE Solutions Platform, and wider dialogue through the *Thrive Blog*.

Outcomes:

Governments, agencies, investors and local stakeholders in Initiative 20by20, AFR100, and the Volta and Tana basins will invest in research-based strategies and programs targeting adoption of restorative practices that enhance ecosystem services. This will lead to the adoption of improved practices by 1.5 million farm households, resulting in 3 Mha with restorative, preventative and climate-relevant practices, with a 5% increase in water- and nutrient-use efficiency in restored lands, and 4 MT CO2-e yr^{-1} sequestered in soils.

Cluster of Activities 1.2 Soil Restoration and Soil Carbon

Countries: **Ethiopia, Kenya**, Tanzania, Ghana**,** Burkina Faso**, Peru,** and Colombia

Description:

This CoA will undertake work on soils necessary to protect and restore soil resources and their ecological functions. This agenda has enormous new support from research and development agencies. In 2014, BMZ launched a special initiative of the One World - No Hunger program, “Soil Rehabilitation for Food Security,” and in 2015, the CGIAR signed a MoU with INRA, CIRAD and IRD to undertake a research program for the *4 per 1000 Initiative*, promising to address the soil science questions and implementation issues to build soil carbon for food security and climate change mitigation. There is still controversy on the achievable amount of soil carbon storage, and the whole question of including soil carbon in measuring, reporting and verification, which needs clarification to achieve investment/policy changes. RDL will focus on critical areas of research needed to support these initiatives. With Livestock, FTA and DCL, this work will advance our understanding of the long-term impact of various interventions on soil organic carbon, soil health and associated food security, food system resilience, and adaptation to climate change. This cluster will continue Phase 1 research on the climate relevance of soil rehabilitation and improved methods for the measurement of soil carbon stocks. It will be linked to CoA 1.1, as soil and landscape restoration can be mutually supportive.

Research questions:
What is the likely impact of different land-use and management practices on the rate and duration of soil carbon sequestration and soil fertility replenishment in tropical soils? What soil organic carbon threshold levels are required to recover and sustain soil function across different soils and climatic environments? How can the production, use and recycling of organic resources be optimized to increase soil carbon storage and soil health? How can soil and landscape restoration be mutually supportive?

What are the returns, social and environmental, for different soil-improving land management practices, and what are the drivers of their adoption? How are or are not soil carbon and soil fertility related to livelihoods? What challenges do male and female farmers have in investing in, maintaining, or increasing soil health? How can the value of soil ecosystem services, including for climate change mitigation, be quantified and incorporated into investment planning and carbon trading?

Theory of change and impact pathway:
This CoA will contribute to large-scale adoption of climate-relevant agricultural practices and interventions that build soil carbon, contributing to mitigation, food security and adaptation. One major target is climate financing, as tied to the '4 per 1000 Initiative' and its partnership (see *Table 2.1.2*). RDL will work with countries that have included agriculture in their Intended Nationally Determined Contributions (INDCs) and have requested to work with the CGIAR through the Green Climate Fund (GCF). With these partners, we will work along the pathways defined by WLE's ToC, with CCAFS in dialogue with policy makers and implementers to support development of readiness to implement climate financing. We will: 1) develop evidence of costs, opportunities and benefits in building soil carbon and soil health to motivate investment aligned with national priorities; 2) co-develop analysis, models and tools, and engage in dialogue with multi-sector stakeholders to increase awareness of potential to build soil organic carbon and soil health, and its importance to people's livelihoods, economically and environmentally, in tropical agricultural landscapes; and 3) develop capacities of national partners and future science leaders to monitor and verify soil carbon stocks, and measure soil health in land restoration and management projects throughout the tropics, supporting progress towards the 4 per *mille* target.

Key outputs:
1. Methodological guides on estimating and measuring soil carbon for carbon trading, and for evaluating the benefits of soil ecosystem services, including supporting landscape restoration and climate change mitigation.
2. Empirical data and predictive models on the potential for soil carbon sequestration under differing management in tropical soils and landscapes.
3. Policy and strategy recommendations for enhancing adoption of land management practices that sequester carbon and build soil health.
4. Knowledge products for presentation at national platforms, UNCCD and UNFCCC COPs and the GLF, peer-reviewed scientific papers, videos, briefs, and blogs for the WLE Solutions Platform and wider dialogue through the *Thrive Blog*.

Outcomes:
Climate financing, national strategies and programs will invest in research-based practices to build soil fertility and soil carbon in three countries, providing food security, adaptation and mitigation benefits. This will lead to the adoption of improved practices by 1.5 million farm households, resulting in 3 Mha with restorative, preventative and climate-relevant practices, with a 5% increase in water- and nutrient-use efficiency in restored lands and 4 MT CO2-e yr^{-1} sequestered in soils.

Cluster of Activities 1.3 Restoration Assessment and Monitoring

Countries: **Ethiopia, Kenya**, **Tanzania**, **Ghana,** Burkina Faso, **Peru**, and **Colombia**

Description:
This CoA will develop and implement an integrating framework for the CGIAR, especially government partners, to prioritize preventive and restorative intervention strategies and monitor progress towards land restoration targets (CGIAR SRF), and to develop cost-effective monitoring relevant to the UNCCD LDN goal (SDG 15). We will conduct a systematic *ex ante* global assessment of land degradation drivers and risks and the impacts of land degradation on ecosystem services and human well-being, and evaluate the costs and benefits of alternative preventive and restorative intervention strategies. This CoA will advance the science of land evaluation, and develop new technologies such as Unmanned Aerial Vehicle (UAV)-based land and crop monitoring, digital mapping, chlorophyll fluorescence as a measure of crop photosynthesis (Guanter et al. 2014), and near infrared spectroscopy as a measure of soil properties (Viscarra and Webster 2012). Emphasis will include further advancing risk and outcome indicators, including hydrological and gender-disaggregated socioeconomic. RDL will place a major emphasis on capacity strengthening of national programs and other restoration agencies (e.g. NGOs such as IUCN, private sector) for restoration assessment, including impact evaluation to better understand what is required to achieve the global targets.

Research questions:
What are the key global and regional risk factors for land degradation, and their impacts on ecosystems and human well-being over the next 30 years? What are the most effective preventive and restorative strategies for reducing and reversing these risks? What are the returns and drivers of adoption of preventive and restorative land management practices?

Which indicators and monitoring methods could be used at different scales to monitor land restoration progress according to resource availability? How can institutions best be strengthened to progress towards achieving the SRF, land degradation neutrality and SDG land restoration targets?

How can stakeholders be effectively engaged in monitoring systems, and how can information on intervention strategies to reduce and reverse land degradation risks be best communicated to policy audiences?

Theory of change and impact pathway:
Based on the WLE and RDL theory of change, this CoA, with CoA 1.1 and the ESA Flagship, will work with governments, NGOs and the private sector to increase capacity in new monitoring and response approaches, measurement methods and analytical tools, as well as the interpretation of results and their application to improving restoration decisions. The availability of regional and global assessments of risks to land health, with economically justified intervention options, will influence restoration policies, strategies and investments by governments, development agencies and donors. This is similar to the Global Burden of Disease Study used to prioritize intervention strategies in public health (Shepherd et al. 2015a). Improved methods and capacities for monitoring changes in land and soil health will provide better evidence on progress towards achieving restoration targets and the impacts of restoration investments.

Key outputs:
1. Projected trends in key land degradation risks and intervention impacts on future land degradation burden and costs over the next 30 years for Africa.

2. New risk-based approaches to screening land restoration options using existing knowledge and low-cost measurements to judge the probability of success or level of economic return.

3. Monitoring framework, reporting guidelines, and training modules and databases on and for land restoration surveillance, risk assessment and land health surveillance approaches relevant to governments, restoration agencies, and local partners for cost-effective tracking of land restoration.

4. Knowledge products for presentation at national platforms and UNCCD COP, peer-reviewed scientific papers, briefs, and blogs for the WLE Solutions Platform, and wider dialogue through the *Thrive Blog*.

Outcomes:
The capacity of national partners to evaluate intervention impacts on land restoration will be enhanced, resulting in national, district, and regional agencies adopting recommended monitoring and verification frameworks for restoration programs. This will lead to 100 trained professionals applying RDL methods for targeting restoration options, risk assessment, and monitoring and evaluating impacts in six countries. This increased capacity in planning and evaluation will in turn increase the cost-effectiveness and impact of restoration programs by at least 20%.

2.1.1.7 Partnerships

RDL sees partners as participants in a dynamic process of innovation. We work with WLE's strategic partners as well as other partners specific to individual CoAs (see *Table 2.1.2*). Importantly, each partnership consortium with which RDL engages, as described below, includes discovery, proof of concept and scaling out partners, to ensure progress along the impact pathway. RDL's role is as a research partner, but also includes proof of concept functions, and important knowledge sharing and networking activities. In addition, especially through WLE's ESA Flagship, RDL will work with others to achieve higher level goals of WLE.

Table 2.1.2 RDL Strategic and CoA-Specific Partnerships

Partner type	WLE centers and CGIAR Research Programs	Discovery/ upstream	Proof of concept/ pilot	Scaling out (downstream)
RDL Flagship (contri-buting to multiple CoAs)	CIAT, ICRAF, **Bioversity, IFPRI, CIP, CIFOR, CCAFS, FTA, DCL, Livestock**	WUR, Wageningen University, ISRIC and Alterra, WRI, IUCN, TNC, IPBES, ELD, LandPKS, national research institutes and universities	**UNCCD, FAO, GIZ, WRI, IUCN, TNC, Governments of Ethiopia, Kenya, Ghana, Tanzania, Colombia, Peru**	World Bank, IFAD, GEF, GIZ, GCF, NARES and NGOs in Ethiopia, Kenya, Ghana, Tanzania, Colombia, Peru
CoA **(additional specific to the CoA)**	CoA 1.1	Stanford University Natural Capital Project, ZEF	UNDP, UNEP, INBAR, TerraGlobal	Tana Water Fund, Volta Basin Authority, NARES, NGOs and investors in Initiative 20x20 and AFR100
	CoA 1.2	**CIRAD, IRD, INRA, IASS, ETH Zurich, Colorado State University**	**Governments in GIZ 'Soil Rehab' and the '4‰' countries**	**NARES and NGOs in GIZ 'Soil Rehab' and the '4‰' countries**
	CoA 1.3	Columbia University, CIESIN, QMUL, JRC, IIASA	**Mars, Danone, IFAD, UN-SDSN, One Acre Fund**	UNCCD pilot countries, One Acre Fund, Mars, Danone

The comparative advantage of RDL within these partnerships is: 1) providing agricultural and natural resource management expertise; 2) an ability to align agriculture and conservation organizations and agendas; 3) a unique position as a knowledge partner/research provider in country-led initiatives through strong relationships with governments and investors; and 4) the ability to facilitate cross-region south-south analysis and exchange.

In brief, RDL's partners are organized by initiatives as follows:

- *Initiative 20x20 convened by WRI*. RDL supports the Initiative 20x20 through its partnership with governments and impact investment funds. As a member of the technical committee and through accompanying research, RDL develops the research evidence needed to allow investment particularly by impact investors.
- *The Upper Tana Water Fund convened by TNC*. As a member of the Steering Committee, RDL provides research evidence, including *ex-ante* and *ex-post* assessment of water quality benefits of various interventions, evaluating trade-offs between agricultural livelihoods and conservation, and enhancing capacity for monitoring results to private sector investors.
- *RDL partners with the Volta Basin Authority in achieving its World Bank-supported Strategic Action Plan*. RDL works with the riparian countries in planning and targeting 10 "ecosystem service conservation and restoration" actions aimed at addressing the impact of soil and vegetative loss and sedimentation of rivers on food, energy, and environmental security.
- *Initiative4‰Soil Carbon for Food Security and Climate Change*, convened by the French research institutes and the CGIAR, to which RDL provides research science on tropical soils and implementation of the CGIAR GCF initiative with CCAFS.
- *The UN SDSN on Data for Sustainable Development*: In partnership with ESA, we will develop guidelines for targeting data collection efforts for improving stakeholder restoration decisions.

In addition, RDL will facilitate CGIAR engagement in global restoration dialogues, working with recognized conveners on land restoration, GLF, IPBES, CBD, GSF, ELD, UNCCD and UNFCCC.

2.1.1.8 Climate change

The Paris Agreement, adopted by the 160 Parties to the UNFCCC in December 2015, for the first time opens the door for more adaptation and mitigation in the agriculture sector. This is because it is based on national climate plans as embodied by the Intended Nationally Determined Contributions (INDCs), 80% of which discuss agriculture. Indeed, reducing emissions from agriculture will be imperative, as it will be impossible to stay within either a 1.5 or 2.0°C target if agriculture does not contribute to emission reductions. This also, for the first time, allows closer integration of the goals of the three Rio Conventions, UNCCD, CBD and UNFCCC, for climate change, food security, land restoration and biodiversity conservation. As a priority in the first three years of Phase 2, RDL will focus climate change-aligned efforts towards interventions that sequester soil carbon in agricultural landscapes - building soil organic matter with climate-smart agriculture - as the nexus between these goals. This work will be aligned with the 4‰ Initiative, part of the Lima Paris Action Agenda that has already been signed by 140 governments and organizations. This represents unprecedented global support for the agenda 'Soils for Food Security and Climate'. RDL will provide strong research on soil carbon dynamics, assessment and monitoring, and interventions, biophysical and social, to achieve soil carbon sequestration in landscapes. We will work

closely with the CCAFS Flagship 3 on mitigation, and CCAFS capacities on developing readiness and engaging in national processes and planning for roll out of climate-smart agriculture.

2.1.1.9 Gender and youth

RDL will contribute to achieving the CGIAR sub-IDO: Gender-equitable control of productive assets and resources. Engaging women in restoration and regeneration efforts, empowering them and enhancing their capabilities (e.g. through access to resources, use of information, credit and/or labor) will allow their knowledge and perceptions to be integrated into decision-making processes and investments affecting land use and management. Much of the work will be based in CoA 1.1. It will work in collaboration with the core Gender and Inclusive Development (GID) theme on understanding the gender aspects of enabling conditions, which encompass power relations and capabilities. In particular, understanding the power barriers to resource access and landownership, and the specific competencies needed to effectively engage in restoration. Linking with issues of incentives, how they are gendered, and the various trade-offs taking place to ensure restoration, will allow for a greater understanding of how to develop enabling conditions to empower women to engage in regeneration. In Phase 1, WLE developed tools to address these issues; in Phase 2, the following research questions will be answered across the landscapes where we work:

- What are the spatial and temporal dynamics affecting the access of women to natural resources that are threatened by degradation?
- What social and economic conditions allow women to engage more actively in restoration?

To set the stage for increased emphasis on youth in the future, RDL will also address the following:

- How do intervention options differentially impact on women and youth?

Cooperation with knowledge partners, such as WUR, will help to intensify the exchange of experience in the area of inclusive green growth, linking business innovation and restoration measures, which may be relevant to youth.

2.1.1.10 Capacity development

A key enabler of WLE's and RDL's impact pathway is capacity strengthening. RDL will contribute to achieving two crosscutting sub-IDOs: increased capacity for innovation in partner development organizations; and enhanced institutional capacity in partner research organizations. Each CoA has identified a specific outcome on capacity development. To achieve these outcomes, RDL will focus on filling gaps in knowledge and capacity identified during Phase 1. Scientists and practitioners from the AFS CRPs and partner organizations will receive training in the latest scientific methods and frameworks needed to assess and adapt restoration practices to different contexts and farmer circumstances (Barrios et al. 2012). RDL will use innovative learning materials and approaches to enhance skills on integrative research approaches that benefit from cutting-edge technologies, e.g. that allow large-scale assessment of spatial and temporal heterogeneity (such as in soil health), together with bottom-up approaches that foster the relevance, credibility and legitimacy required for enhanced adoption of soil restoration practices. RDL will address the need for gender-sensitive approaches to capacity development that pay particular attention to the issues raised above (Section 1.0.10). This highlights the need to understand and build the capabilities to empower women to engage in land restoration, recognizing that training needs given the gendered nature of land restoration, and how science can better integrate these factors

in research, analysis and planning. We expect our capacity development efforts to reach up to 2,000 partners, resulting in a new generation of well-trained and gender-balanced scientists, ministries, national and sub-national planners, and practitioners with skills to guide and steer improved policies and programs for land restoration. *Table 2.1.3* documents the CGIAR CapDev elements RDL will prioritize.

Table 2.1.3 CapDev Elements Prioritized by RDL

CapDev Element	CoA 1.1	CoA 1.2	CoA 1.3
Needs assessments and intervention strategy			
Learning materials and approaches			
Developing CRPs' and centers' partnering capacity			
Develop future research leaders			
Gender-sensitive approaches			
Institutional strengthening			
Monitoring and evaluation			
Organizational development			
Research on capacity development			
Capacity to innovate			
Key	High	Medium	

2.1.1.11 Intellectual asset and open access management

RDL manages research products following the CGIAR Principles on the Management of Intellectual Assets and their Implementation Guidelines. All RDL research products are considered International Public Goods to maximize their impact, in a manner that fosters achieving the CGIAR SLOs. To that end, all datasets, applications and tools developed will be published and made available online, including through the Harvard Dataverse system and GitHub. ICRAF hosts a large open access database on soil health indicators, and RDL will be a key contributor to the database. Publications from the Phase 1 CoA that are open access has been growing, with a goal of close to 50% at the start of Phase 2. All partners will be supported to commit to the CGIAR Principles on the Management of Intellectual Assets and the CGIAR Open Access and Data Management Policy. This will be ensured, amongst other means, through contractual agreements. Budget support for continuous increase of open access publishing will be factored into joint proposals.

2.1.1.12 Flagship management

The RDL Flagship will be jointly led and managed by Principal Scientists from CIAT and ICRAF. These scientists have strong scientific records, and significant experience leading large multi-disciplinary programs. Within the Flagship, CIAT will take primary leadership of CoA 1.1, and ICRAF of CoA 1.3, while CoA 1.2 will be jointly managed. The RDL Flagship co-leaders are jointly responsible for driving the flagship strategy and achieving its plan within the boundaries of W1/2 allocation. Regular virtual meetings will keep the core partners fully engaged. The Flagship will be represented in the WLE MC through its two co-leaders. Flagship management will be subject to the proposed CRP performance assessment framework and Performance Monitoring Plan.

2.1.2 Flagship Budget Narrative

2.1.2.1 General Information

CRP Name	Water, Land and Ecosystems
CRP Lead Center	IWMI
Flagship Name	Flagship 1: Restoring Degraded Landscapes (RDL)
Center location of Flagship Leader	CIAT

2.1.2.2 Summary

Table 2.1.4 Flagship Budget Details

Total Flagship budget summary by sources of funding (USD)

Funding Needed	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	2,045,377	2,147,646	2,255,029	2,367,780	2,486,169	2,610,478	13,912,482
W3	0	0	0	0	0	0	0
Bilateral	9,600,000	10,080,000	10,584,000	11,642,400	12,806,640	14,087,304	68,800,344
Other Sources	0	0	0	0	0	0	0
	11,645,377	12,227,646	12,839,029	14,010,180	15,292,809	16,697,782	82,712,823

Funding Secured	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Assumed Secured)	2,045,377	2,147,646	2,255,029	2,367,780	2,486,169	2,610,478	13,912,482
W3	0	0	0	0	0	0	0
Bilateral	4,488,167	2,499,459	1,184,711	0	0	0	8,172,338
Other Sources	0	0	0	0	0	0	0
	6,533,544	4,647,105	3,439,740	2,367,780	2,486,169	2,610,478	22,084,816

Funding Gap	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Required from SO)	0	0	0	0	0	0	0
W3 (Required from FC Members)	0	0	0	0	0	0	0
Bilateral (Fundraising)	-5,111,832	-7,580,540	-9,399,289	-11,642,400	-12,806,640	-14,087,304	-60,628,006
Other Sources (Fundraising)	0	0	0	0	0	0	0
	-5,111,833	-7,580,540	-9,399,289	-11,642,400	-12,806,640	-14,087,304	-60,628,006

Total Flagship budget by Natural Classifications (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
Personnel	4,661,537	4,983,675	5,270,336	5,668,305	6,012,564	6,620,689	33,217,107
Travel	858,516	1,047,975	1,129,108	1,146,928	1,206,899	1,297,252	6,686,681
Capital Equipment	11,958	12,556	88,162	14,300	15,573	16,968	159,519
Other Supplies and Services	1,938,467	1,939,015	1,996,422	2,702,328	3,117,621	3,577,400	15,271,255
CGIAR collaborations	4,666	4,678	4,690	7,030	7,061	8,193	36,320
Non CGIAR Collaborations	2,806,316	2,807,613	2,843,481	2,824,302	3,132,402	3,208,392	17,622,508
Indirect Cost	1,363,916	1,432,132	1,506,827	1,646,984	1,800,687	1,968,884	9,719,433
	11,645,376	12,227,644	12,839,026	14,010,177	15,292,807	16,697,778	82,712,808

Total Flagship budget by participating partners (signed PPAs) (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
IWMI	0	0	0	0	0	0	0
Bioversity International	1,419,213	1,490,174	1,564,682	1,706,518	1,861,807	2,031,855	10,074,251
IFPRI	922,136	968,243	1,016,655	1,109,889	1,212,026	1,323,932	6,552,885
ICRAF	4,606,306	4,836,622	5,078,453	5,544,110	6,054,224	6,613,133	32,732,850
CIAT	4,600,375	4,830,394	5,071,914	5,536,972	6,046,430	6,604,621	32,690,709
IWMI - WLE	97,344	102,211	107,322	112,688	118,323	124,239	662,130
	11,645,374	12,227,644	12,839,026	14,010,177	15,292,807	16,697,780	82,712,808

The total budget request for RDL is $82.7m for a period of six years, mainly funded from bilateral grants to the extent of 83% and the remaining funds from W1/W2.

RDL will develop bilateral resources and leverage Windows 1 and 2 funds to generate evidence-based research to assist country-led initiatives and investments in regenerative and restorative landscape management practices to slow or reverse on-going degradation of land, soil, water and biodiversity resources. This research will restore degraded lands in vulnerable ecosystems in sub-Saharan Africa and Latin America, together with the AFS-CRPs; it will develop evidence of cost effective restoration options and identify incentives necessary to implement and adopt them; it will enhance the role of soil organic matter in food security and climate change adaptation and mitigation; and co-develop systems for targeting, monitoring and learning. To do so, WLE will spend approximately 40% of funds for CGIAR staff salaries. Approximately 21% of funds will be used to work with various collaborators to achieve key outputs and outcomes under the CGIAR SRF; 18% of resources go to supplies and services, and 12% is projected for overhead. Approximately 35% of the resources will be spent in Africa and approximately another 30% will be spent on Latin America. The remaining funds will be used for larger regional work, development of tools and global analyses, and capacity building. Approximately equal shares of funding will be spent on CoA 1.1 (landscape restoration) and CoA 1.2 (soil restoration and soil carbon), and a smaller share on CoA 1.3 (restoration assessment and monitoring).

The highest risks for this flagship are instability of funding and increase of costs due to change in the external and internal environment. The Program Management Unit, with guidance from the Lead Center, will review risks on a quarterly basis and track impacts on budgets, adjusting as appropriate. The major risk in budgeting is the limited knowledge available of the funding landscape over the next six years. We have addressed this risk by diversifying our WLE Phase 2 funding strategy toward a broader range of donors; by prioritizing research activities with large potential impacts, planning to add areas of research only as funding availability increases; and co-financing joint work with AFS CRPs.

For example, in Phase 2, RDL will work directly with the FTA and Livestock CRPs within large scale restoration initiatives active in Eastern Africa and Latin America, to raise bilateral funding and so that their regenerating and restorative technologies are incorporated into landscape solutions. We will also leverage our work with other Integrating CRPs, specifically CCAFS on restoring soil carbon as a food security and climate change adaptation and mitigation strategy.

A second potential risk relates to uptake of research results by targeted end-users. We believe that WLE and the CGIAR have developed close levels of engagement in countries, regions and global agencies targeted by RDL. We will also ensure engagement of actors early on and involve them throughout the research process. We have reserved approximately 21% of resources for engagement with non-CGIAR collaborators. The budget presented includes bilateral agreements that are yet to be approved and signed. The assumption is that the bilateral funding mentioned in this budget will materialize. The success of using partnerships will largely depend on the consistency of bilateral funding.

The breakdown of costs by targets, sub-IDOs and outcomes is stated in the PIM tables and budget.

2.1.2.3 Additional explanations for certain accounting categories

The components of benefits are, home leave, pension, vehicles, housing, educational allowance, and health insurance. Each center working as part of this program has clear policies and procedures with regards to each of the above cost components which may differ from center to center and category of employment (national, regional, international, etc.). The policies vary among partner centers and are based on local laws and needs.

Supplies and services are budgeted as per the costing principles laid out in Financial Guidelines 5 issued by the Consortium Office.

The cost can be broadly categorized into two categories:

1. Research Support and Quality and Coordination costs: Services or research support costs for a CGIAR Center include research oversight, facilities (or occupancy costs) and general services like rent, utilities, IT, phone/fax etc. Other costs include project oversight, data management and depository, and output quality control which are not fully charged on common budget lines.

2. The calculation of charge out rates is based on CGIAR Financial Guideline Series No 5 whereby costs that are not directly research related are treated as research support. The cost of the services is allocated to benefiting projects based on utilization of these services by research staff. Utilization is measured by the number of direct labor hours incurred by research staff while providing direct research support under each project.

The direct costs include consulting services, professional services, publications or subscriptions, conferences/ workshops, communications, postage and other miscellaneous costs which are essential to conduct the planned activities and achieve the targeted outcomes.

2.1.2.3 Other sources of funding for this project

RDL is developing a very broad funding strategy which was initiated in Phase 1 and encompasses traditional bilateral donors as well as private foundations, the private sector, multilaterals and national governments. RDL has had success with all these types of donors.

RDL has a clear strategy that prioritizes three areas of work. First, addressing on-going degradation of land, soil, water and biodiversity resources in Africa and Latin America, where degradation is having a

large negative impact on prosperity and food security. This area is of specific interest to governments, impact investors, and local stakeholders interested in high value ecosystems services such as clean and reliable water supplies. Second, an emerging area is the value of soil organic matter (soil carbon sequestration) for food security and climate change mitigation. This has recently emerged and is potentially of strong interest to climate financing, because it addresses multiple issues, adaptation, food security, restoration and mitigation. The third area is to increase capacity and provide new cost effective tools for verification and monitoring, for which demand is also increasing due to the adoption of the SDGs and associated goals and targets related to the Land Degradation Neutral aspirations.

Thus all foreseeable funding sources have been included and activities reduced to those that have a high probability of producing outcomes. If funding does not become available, the geographic scope will be reduced. The scope will be highly dependent on bilateral funding, which often has a specific geographic focus. Also, if funding does not crystallize as expected, the CRP and its flagships will discuss options for optimizing funding and damage control. Solutions would include targeted fund-raising campaigns, within- and across-center staff relocations to cover critical gaps, and W1/2 support limited to the most promising projects. There are limited options for in-kind or reserve contributions.

2.1.2.4 Budgeted costs for certain key activities

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
Gender	1,440,000	10% of the Flagship budget will be dedicated to gender research, and it is anticipated to grow over time. Much of this work is housed in CoA 1.1. Within this CoA, the funding will be dedicated to: 1) understanding the gendered power barriers and capabilities need for resource access and land ownership; 2) calculating the gendered costs and benefits of ecosystems services to different community members; and 3) building on successful community initiatives on restoration identified in Phase 1 for out-scaling in Phase 2. This will be done through a systematic evaluation, identification and development of approaches and incentives for land restoration, especially those that can motivate and empower women, and will contribute to the outputs under the flagship: 'Comparative assessment of factors affecting success and failure of restoration leading to recommendations for the design of new restoration initiatives'; and 'Innovative restoration pilots that implement incentives and enabling conditions for adoption of sustainable and equitable restoration interventions'. The Flagship, with the help of GID, and incorporating these planned activities, will develop a three-year gender plan, which will be accompanied by a dedicated gender budget. A concerted effort will also be made to seek bilateral support to implement activities that explicitly support the gender plan.
Youth (only for those who have relevant set of	720,000	This Flagship does not have a specific focus on youth. However, to set the stage for increased emphasis on youth in the future, RDL will address the following question in CoA 1.1: "How do intervention

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
activities in this area)		options differentially impact on women and youth?" Cooperation with knowledge partners such as WUR will help to intensify the exchange of experience in the area of inclusive green growth, linking business innovation and restoration measures, which may have relevance to youth. Initially, a limited amount of seed money will be used to identify specific entry point on youth in RDL to develop a more coherent approach on youth in RDL.
Capacity development	1,704,000	Approximately 10% of the RDL budget is dedicated to capacity development (CapDev) that is central to the RDL's ToC and Impact Pathway. Training modules and databases on and for risk assessment and land health surveillance approaches relevant to governments, restoration agencies, and local partners for cost-effective tracking of land restoration are planned (CoA 1.3). This output will require generation of innovative learning materials for courses carefully targeted to the different levels and partner capacity needs in each country. The learning materials will be developed in collaboration with partner organizations and outsourced to consultants as needed for aspects related to instructional design and development of the training manuals/modules. RDL will facilitate CGIAR engagement in global restoration dialogues, working with recognized conveners on land restoration. The facilitation of the dialogues requires dedicated staff for identifying stakeholders, preparing materials, convening events (face to face and virtual), and knowledge sharing. RDL also budgets for the development and sharing of materials, cost of convening and participating in dialogue events (including travel), on-line knowledge sharing platforms (licenses, IT staff). RDL puts strong attention to development of future research/ science leaders, in the areas of land assessment, soil carbon dynamics and ecosystem services trade off analysis and monitoring. For this, RDL budgets for the costs of fellowships, degree training, internships and scholar exchanges within project budgets.
Impact assessment	216,000	Impact assessments will be built into project activities where relevant. The following studies are already planned: seeds for restoration needs, MESH model, and on land use practices. The budget for impact assessment is part of a broader budget for Monitoring, Evaluation, Impact Assessment and Learning (MEL), for which approximately 10% of the time of each Flagship Leader and 5% of the time of Project Leaders will be allocated, including reporting and oversight. The other costs related to MEL which are included in this Flagship Budget are baseline, sampling, data

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		collection and follow-up. These are incorporated into the lines on travel, supplies and services.
Intellectual asset management	278,400	Compliance with the CGIAR Principles on the Management of Intellectual Assets is a task of each WLE partner center and backstopped by the Lead Center Legal officer and Business Development Director, covered by Supplies and Services budget line.
Open access and data management	120,000	Compliance with the CGIAR Open Access and Data Management Policy is a task of each WLE partner center, and not funded by individual flagships. However, flagships will encourage researchers to budget in proposals, resources to cover OA/OD, like open access fees for articles; database membership fees; server and hardware costs. Staffing costs will be covered by a combination of personnel costs and supplies and services. RDL will disseminate its research through the WLE website, blog and solutions platform.
Communication	720,000	The resources required for Knowledge Management and Communication (KMC) in RDL is included in project budgets, funded by W1/2 or bilateral. RDL knowledge products include: manuals, interactive tools, briefing notes, support to facilitation of dialogue/ multi-stakeholder processes, engagement in events at national/ regional/ international levels; and production of materials for use in development processes (participatory video, press, radio, TV). As the focus on KMC at flagship level is on integrating and demonstrating the impacts and results of research, WLE KMC will involve uptake/ communication staff based within the Centers leading this flagship and work closely with program level KMC.

2.1.2.5 Other

The indirect costs in this budget includes costs for the support service units like HR, finance, administration etc. In case there is a sudden decrease of funding, indirect costs will remain at a higher rate as it will take time to make adjustments. The indirect cost rate is based on FG 5 of CGIAR Cost allocation guidelines.

The highest risks with regards to this project is instability of funding and increase of costs due to change in external and internal environment. The program team under the leadership of the Lead Center will review the risks on a quarterly basis and ensure that budgetary adjustments are tracked due to these risks.

The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the bilaterals mentioned in this budget will be approved without any variance.

Partnership are largely supported through bilateral funding, which reduces the systemic risk from fluctuations in windows funding.

Inflation is considered in the costs at 2.63% which is based on the average IMF projections for the next 6 years.

2.1.3 Flagship Uplift Budget

Outcome Description	Amount Needed	W1 + W2 (%)	W3 (%)	Bilateral (%)	Other (%)
Outcome 1.4 Expansion of the program of work into 4 additional countries in Asia and Africa.	33,601,800	50	0	50	0

2.2 WLE Flagship 2: Land and Water Solutions for Sustainable Intensification (LWS)[14]

2.2.1 Flagship Narrative

2.2.1.1 Rationale and scope

Agriculture, including both crop and livestock production systems, is the largest global user of land and water resources and provides employment for over one billion people, about 30-40% of the labor force, including the highest proportion of female and child labor in developing economies (ILO 2011)[15]. Yet, large yield gaps persist, particularly in smallholder farming landscapes. With food demand driven by rising incomes in Asia and rapid population growth in sub-Saharan Africa, food deficits are predicted. These deficits must be met by increasing imports (GHI 2012) or through sustainable intensification (Montpellier Panel 2013). In developing countries where WLE is active, rapid demographic changes are taking place together with lack of resilient livelihood options in rural areas. These challenges require a paradigm shift in how to transform agricultural landscapes. This will include evidence-based investments to improve productivity and restore degraded agro-ecosystems, alongside reduction of gendered barriers to ensure profitability for men and women farmers. Underpinning this will be the need to develop and apply agricultural land and water management (ALWM) solutions by smallholder farmers at landscape scale.

There is an untapped potential to achieve sustainable intensification in agricultural landscapes in developing countries. Recent WLE research (Giordano et al. 2012) shows that targeted investments in ALWM and associated policy interventions can double or triple crop yields, and generate net revenues benefiting millions of people (*Table 2.2.1*). Global analyses indicate that small increases in water productivity could meet the food needs of more than 100 million people (Brauman et al. 2013; Jägermeyr et al. 2016). The management of rainfed and irrigation systems must be transformed to meet rising food requirements, using agricultural landscapes more efficiently and equitably. Applying a systems approach for ALWM solutions will require new institutional and policy arrangements, links to markets to provide incomes to farmers, and new incentives to sustainably manage the natural assets of landscapes (Marques et al. 2016). ALWM practices encompass soil, land and water technologies and management interventions from field to landscape scale. These include rainfed systems' soil and water conservation, water infiltration and storage at landscape scale, and small, medium and large irrigation systems for smallholder farmers.

Table 2.2.1 Potential Benefits from Investments in Three ALWM Solutions

Solution	Sub-Saharan Africa		South Asia	
	People reached (Million)	Net increase HH income (USD billions/yr)	People reached (Million)	Net increase HH income (USD billions/yr)
Motor pumps	185	22	40	4
Rainwater harvesting	147	9	205	6
Small reservoirs	369	20	N/A	N/A

Source: Giordano et al. 2012. HH = household.

[14] All acronyms are defined when first used and then summarized in Annex 3.14.
[15] All references are listed in Annex 3.15.

The Land and Water Solutions for Sustainable Intensification (LWS) Flagship will develop new knowledge and approaches to achieve more productive and resilient agricultural production across the continuum from rainfed to fully irrigated systems (Molden 2007). With local and international partners, including selected AFS CRPs, LWS will pilot, test and provide evidence to support decisions and investments in out-scaling of ALWM. LWS addresses the Grand Challenges of *competition for land and water*, *overdrawn and polluted water*, and *climate change* (CGIAR 2015) by: 1) sustainable intensification through ALWM solutions at landscape scale in different environmental, social-institutional and technological contexts (Cluster of Activities [CoA] 2.1); 2) transformation of medium- and large-scale irrigation systems and management institutions for more equitable service delivery and improved management of problem soils in irrigated areas supporting sustainable increases in food security and ecosystem services (CoA 2.2). LWS will contribute to the targets defined in SDGs 1, 5, 6 and 15 by focusing on improving water productivity across all sectors. Recent gender research in Ghana and Zambia shows that due to lack of access to financing, female-headed households adopt irrigation at only two-thirds of the rate of male-headed households (van Koppen et al. 2013). LWS will prioritize gender and equity, recognizing that empowering men and women to enable equitable opportunities needs better informed investments and increased access for productive use of land and water.

The LWS partners include IWMI, ICRISAT, and ICARDA, as well as ILRI, IFPRI, and FAO. A range of strategic boundary partners are involved in knowledge development, use of new knowledge, and enhanced out scaling. Within WLE, LWS will collaborate with all the other flagships and the core theme Gender and Inclusive Development (GID) on gender and youth issues. LWS will work in collaboration with DCL and Rice CRPs, and with the Integrating Programs on Climate Change (CCAFS) and Policy and Institutions (PIM).

2.2.1.2 Objectives and targets

The objective of LWS is to deliver innovative science into practice that will help unlock the potential values of more resilient farming systems. Taking an agro-ecological landscape perspective, and recognizing the substantive challenges of balancing competing trade-offs, LWS will seek the triple win of greater environmental sustainability, increased agricultural productivity and more equitable benefits.

In partnerships with AFS CRPs and agricultural communities, LWS will provide research evidence on processes and opportunities for adoption of sustainable ALWM solutions at scale. New knowledge is required to: 1) understand the complex and dynamic biophysical, socioeconomic and institutional factors that influence productivity of water and land resources under agricultural intensification in diverse, and often contested, agro-ecological landscapes; 2) understand the major determinants of adoption of ALWM solutions, including the role of credit, farmers' willingness to pay, service provision, and the role of public and private sectors; 3) identify ways to overcome barriers (power relations, capabilities, access) to enable women and youth to engage in and benefit from ALWM tools and solutions; 4) identify synergies, tools and solutions (policy, management, technical) across scales and between sectors; and 5) translate new knowledge into use through strategic partnerships with international financial institutions (IFIs), policymakers and development agents. LWS takes a highly interdisciplinary approach, involving scientific experience from agronomy, ecology, irrigation, social science, political science and engineering.

LWS will contribute to global development agendas, including the SDGs, the UNFCCC Paris agreement and national agendas for sustainable intensification, through research that supports national and regional initiatives, particularly large-scale land management projects aiming for cumulative benefits to smallholder farming households. LWS and its partners have a comparative advantage in integrated ALWM innovations that have been developed and tested, with proven development impact, in several regions (see Section 2.2.1.5). LWS will focus resources in Ethiopia, Ghana, India, Egypt and Vietnam, and further

develop bilateral funding for the LWS agenda in Burkina Faso, Mali, Nepal, Niger, Nigeria, Tanzania, Zimbabwe, Pakistan and Uzbekistan.

LWS will primarily contribute to achieving CGIAR SLO 3 "improved natural resources and ecosystem services" (Sub-IDOs 3.2.1, 3.2.2, 3.3.1), as well as SLO 1 "reduced poverty" (sub-IDOs 1.1.2) and increased resilience of the poor to impacts of climate change (Sub-IDO A.1.1) (*Table 2.2.2*). The crosscutting issues of gender and youth will be addressed primarily through research to support "gender-equitable control of productive assets and resources" (Sub-IDO B.2.2). Building on current and planned research, with existing and new strategic partnerships with other CRPs, development partners and primary stakeholders (see Sections 2.2.1.3 and 2.2.1.7), LWS will support capacity development (sub-IDO D.1.4) to facilitate, by 2022, the following:

- Implementation of new and refined **investment options** for improving delivery and maintenance of ALWM solutions, mainly in WLE Phase 1 focal areas (East and West Africa, South Asia) **benefiting 1.5 million households** (Outcomes 2.1 and 2.2).
- **Empowerment of one million women** through the development and facilitated implementation of ALWM solutions, ICT innovations and irrigation system performance improvements that remove barriers to accessing productive resources (Outcome 2.1 and 2.2).[16]
- **Investment** in irrigation strategies in groundwater-stressed South Asia, to radically reduce energy and water consumption, enabling two million (of a potential 19 million) farmers to use grid-connected solar pumps (Outcome 2.1 and 2.2).[17]
- **Improved design of targeted investments** of USD 3 billion in irrigation modernization in Africa and Asia, benefiting about 1.5 million farm households (Outcomes 2.2 and 2.3).
- **Increased water productivity,** improved conveyance and application efficiency by an average of 5% in selected irrigation systems and rainfed systems across 7.5 Mha in basins in Africa, and South and Central Asia (Outcomes 2.2 and 2.3).

Table 2.2.2: CGIAR Sub-IDOs and LWS Activities 2017-2022

CoA	SLO and IDOs addressed	Key countries	Outcomes	2022 Targets	Budget (USD '000)
2.1	SLO 1 – Reduced poverty- 1.1.2 Reduced production risk (SDG 1, 2) A-1.4 Enhanced capacity to deal with climate extremes B.2.2 Gender-equitable control of productive assets and resources (SDG 5)	***Ethiopia, Ghana, India*** *Burkina Faso, Mali, Nepal, Niger, Tanzania, Zimbabwe*	*Outcome 2.1* Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM and irrigation	Adoption of ALWM solutions benefit 2 million HH in WLE and AFS CRP landscapes (30% female)	29, 683
2.2		**Egypt, Ethiopia, India, Vietnam**, Ghana, Nigeria, Pakistan, Zimbabwe		Improved irrigation system management benefits over 1 million farm	

[16] From AgWater Solutions regional http://awm-solutions.iwmi.org/regional-mapping.aspx and country http://awm-solutions.iwmi.org/country-mapping.aspx modeling projections.

[17] From IWMI studies www.financialexpress.com/article/fe-columnist/harvesting-solar-riches/59262/.

CoA	SLO and IDOs addressed	Key countries	Outcomes	2022 Targets	Budget (USD '000)
	D.1.4 Increased capacity for innovation in partner development organizations and in poor and vulnerable communities		operations in at least 4 countries	households (30% female)	
2.1	SLO 3 – Improved natural resource systems and ecosystem services 3.2 1 More productive and equitable management of natural resources 3.2.2 Agricultural systems diversified and intensified in ways that protect soils and water (in irrigated agro-ecosystems) 3.3.1 Increased resilience of agro-ecosystems, especially those including smallholders (SDG 2, 6, 15) A.-1.4 Enhanced capacity to deal with climate extremes B.-2.2 Gender-equitable control of productive assets and resources (SDG 5) D.1.4 Increased capacity for innovation in partner development organizations, and in poor and vulnerable communities	**Ethiopia, Ghana, India** Burkina Faso, Mali, Nepal, Niger, Tanzania, Zimbabwe	*Outcome 2.2* Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation Outcome 2.3 Coordinated management of problem soils and waters implemented in irrigation systems with substantial areas of degraded soils	Increased water-use efficiency and water productivity by over 5% in targeted ALWM rainfed and irrigation systems in Africa and South Asia on over 5 Mha	44,524
2.2		**Egypt, Ethiopia, India, Vietnam,** Ghana, Nigeria, Pakistan, Uzbekistan, Zimbabwe		Water delivery services increase water productivity in over 2.5 Mha of irrigation systems	

Note: **Bold** = primary country

Expanded scope under uplift budget

In the uplift budget scenario, additional research will be done with AFS CRP teams to address ALWM issues in two more countries with large irrigated areas with poor small farmers (Pakistan and Uzbekistan). This will extend benefits to about 1.5 million more rural households and increase the area using improved management approaches and tools, contributing to sub-IDOs 1.1.2, 3.2.1, 3.2.2, and 3.3.1, and the crosscutting Gender and Youth sub-IDO (B.2.2 Gender-equitable control of productive assets). The uplift budget will also be applied to expand research on links between water for productive use and the role of gender capabilities by further exploring gendered aspirations to engage meaningfully with change in the world (Bebbington 1999).

2.2.1.3 Impact pathway and theory of change

Aligned with the overall WLE theory of change (ToC) and the CGIAR focus on landscape management, LWS research will develop new knowledge and evidence on options for, and outcomes of, landscape-scale ALWM. LWS will provide the research foundation for advice and recommendations to decision makers to change perceptions and behavior towards increased adoption of ALWM innovations. LWS will provide evidence on the benefits of directly engaging women and youth for sustainable increase of agricultural productivity at scale. Working with R4D partners, global dialogue organizations, IFIs, and national and regional leaders, LWS will bring about change through four impact pathways (*Figure 2.2.1*), building on experiences, success and partnerships established during WLE Phase 1. To achieve the planned outcomes (Section 2.2.2), the LWS activity clusters will: 1) build on existing strengths and activities of LWS; 2) concentrate in specific regions and countries to reduce transaction costs; and 3) strengthen strategic partnerships along the impact pathways. An integral part of the LWS ToC is an iterative learning process with key boundary partners in pilot and scaling stages, to evaluate and adjust the assumptions, actors and pathways outlined. LWS's impact pathway in *Figure 2.2.1* identifies several assumptions and recognizes that contexts will likely change during implementation 2017-2022.

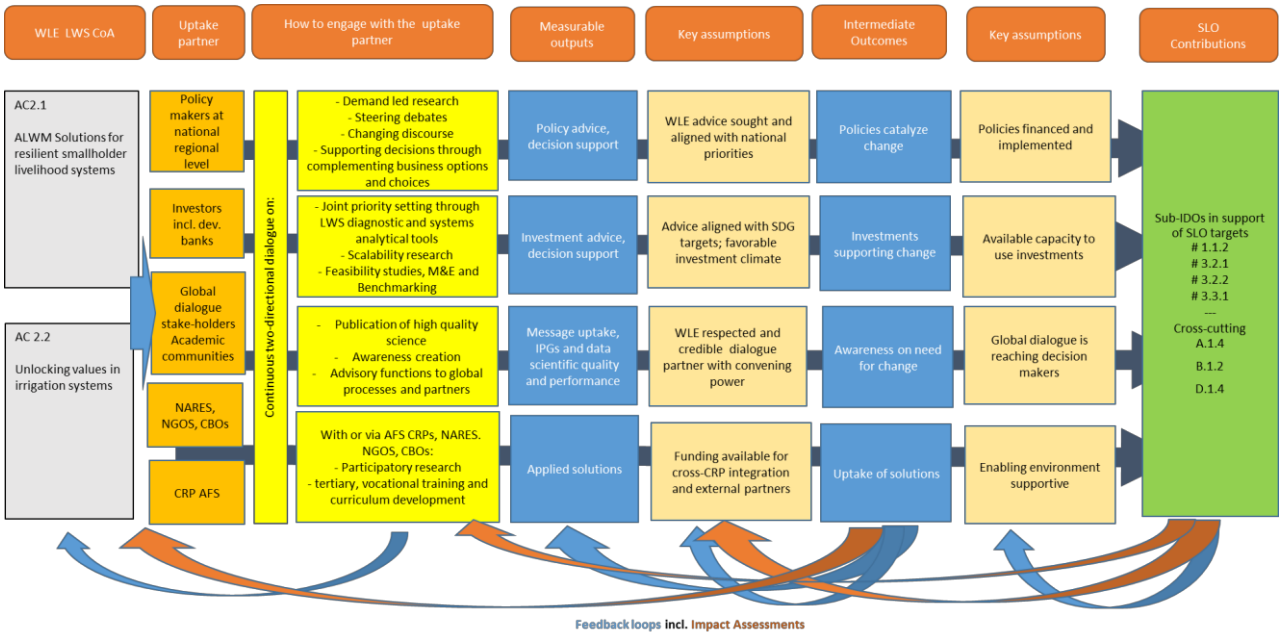


Figure 2.2.1 Principal Impact Pathway for LWS Activities and Products

Innovative science is a core feature of LWS. LWS and its partners will produce international public goods (IPGs) **to guide public and private sector investments in land and water productivity** (*Box 2.2.1*) and to support broader policy and sustainable development objectives. Recognizing that boundary partners will

require different engagement approaches, LWS will, in addition to producing scientific publications, engage in partnerships and communication through a range of R4D activities. An underlying assumption that "*seeing is believing*" is equally true whether dealing with individual resource-poor farmers, irrigation system managers, policy makers, or investment decision makers. Therefore, LWS will undertake pilot and proof-of-concept research in partnership with women and men farmers, relevant local public sector agencies, CBOs/NGOs and selected AFS CRPs. LWS will engage with policy and decision makers at national and sub-national level to promote improved enabling conditions for multiple ALWM technologies along the rainfed-irrigation continuum, including joint policy partnership platforms[18], responding to invitations for advice from ministries, and development of targeted decision support products by demand.

LWS has past experience in these pathways to impact in strategic partnerships. The AgWater Solutions project (Giordano et al. 2012) showed that influencing investment decisions by national agencies, IFIs and development partners is a critical pathway to create enabling conditions for out scaling of ALWM for impact. Linkages with IFIs will be strengthened by engaging in co-design of research programs, providing early access to research provided through advisory services, and reviews of investment programs. Recent examples include reviews and advisory services for ADB, World Bank and IFAD.[19] Core assumptions are: 1) donors are willing to adopt practices based on new evidence; 2) governments and development partners continue their current increased interest in development, rehabilitation and modernization of irrigation infrastructure and reform of service providers;[20] and 3) investments in smallholder ALWM continue at current or increased levels. LWS will focus on influencing the investment plans and decisions of IFAD, World Bank, AfDB and ADB and national line agencies in focal countries.[21]

Box 2.2.1: **Types of IPGs (LWS and CRP AFS)**

- **Synthesized knowledge** of "levers of change" to accelerate sustainable intensification;
- **Baseline and benchmark indicator systems** and monitoring data on water-use efficiency (WUE), consumption and productivity in irrigated and rainfed agro-ecological landscapes (with ESA and AFS CRPs).
- **Diagnostic, systems analytical and monitoring tools** to assess and monitor biophysical, social and environmental implications of ALWM investment scenarios at multiple scales (with RDL, ESA, VCR and selected AFS CRPs).
- **Institutional arrangements and incentive systems** to empower communities (including women, the young and marginalized groups) to enhance the productive and equitable management of natural resources (with GID).
- **New approaches to transforming irrigation performance**, including salinity management**,** and practices using organizational change management (with RDL, ESA and selected AFS CRPs).
- **Investment options and decision support frameworks** to guide how and where to invest in sustainable ALWM practices at scale (with RDL and selected AFS CRPs).

[18]Multi-stakeholders' National Platform on Agricultural Water Management (AWM), Ethiopia, 2015.

[19]ADB TA7967-REG Innovations for More Food-Less Water, Manila, December 2011; IWMI Consultants Report- TA7967-REG. Innovations for More Food-Less Water – March 2015; Participation in advisory committee for WB Sahel irrigation Initiative.

[20] Large-scale irrigation investments, include World Bank: USD 7 billion in the Sahel 2016-2022; USD 440 million in Nigeria 2016-2020; AfDB USD 4.5 million Prefeasibility Irrigation Development Studies in Mozambique 2016; ADB USD 650 million Mahaweli Water Security Investment Program, Sri Lanka, 2015.

[21] These remain high on national and investor agendas, including in Ethiopia for PASDEP II; and with national and regional policies continuing to include targets for smallholder ALWM.

Capacity development will include involving junior and senior researchers in LWS R4D, especially in the focal countries, Ethiopia, Ghana, India, Egypt and Vietnam, and collaboration to incorporate new science into tertiary education curricula creating the future cadre of researchers, sector professionals and policy makers. LWS will work with vocational training organizations to develop the capacity of service providers, farmers and managers and operators to address equity and sustainability objectives in the highly contested environment of large and small irrigation systems.

2.2.1.4 Science quality

LWS builds on an existing strong foundation of developing scientific evidence on ALWM solutions for agro-ecological landscapes and facilitating science into practice through partnerships along the respective pathways to outcomes and impacts. The evaluation of WLE Phase 1 (IEA 2016) stated that the predecessor of LWS is "*well-focused on research for development*", and that research on "*the higher biophysical (landscape, watershed, regional, global) and social (socioeconomic, institutional) scales [is] in keeping with WLE's comparative advantage among CRPs.*"

LWS will continue to **focus with its partners on cutting-edge interdisciplinary research on agricultural transformation at landscape scales**. IEA (2016) found this to be a particularly innovative feature of LWP, and noted that *"The scaling and integrative focus renders the work innovative when compared with mainstream academic work in land and water productivity"*. Research to understand and support the transformation of coupled biophysical and social systems in rapidly changing agro-ecological landscapes continues to be a strategic R4D contribution of CGIAR. Landscape-scale impacts are the least well understood in terms of threshold responses for biophysical processes, including ecosystem services when land use, water appropriation and biodiversity change under agricultural intensification. The landscape scale also presents challenges to empirical research and modelling that LWS addresses by collecting data and developing methods to support more desirable transformations which are then piloted through LWS activities and locations (for example, Gumma et al. 2015; Singh et al. 2014). Further, LWS will advance scientific evidence on the interactions between enabling conditions for ALWM uptake and out scaling in order to identify opportunities and levers of change for policy and investment interventions. In addition, a new R4D agenda around medium and large-scale irrigation systems is being developed, to attain more equitable benefits while recasting irrigation systems to provide sustainable ecosystem services (e.g. Amede 2015; Javaid and Falk 2015). These three interdisciplinary core thrusts will advance the research and innovation of LWS, and continue to provide LWS partners with science-based evidence for change.

The LWS predecessor flagship has **a strong publication record in relevant interdisciplinary fields**. The IEA found LWP to be "*highly interdisciplinary with several good to excellent publications*". Peer-reviewed publications in LWP activities during 2012-2014 were typically in water, agriculture, policy and development-related journals. Of 106 listed peer-reviewed papers, 70% had an average ISI score of 1.701.

The LWS core research team includes ten researchers drawn from ICRISAT, IWMI, ICARDA, ILRI, and IFPRI in collaboration with FAO. Three of the lead researchers have an h-index greater than 21, and the others each have an h-index of between 10-20, indicating the team's capacity to assure the scientific quality and strategic research direction of LWS. IEA (2016) noted "*indices between 10 and 20 in scientific areas such as those covered by WLE would be widely accepted benchmarks for tenure and promotion to full professor in academia and an h-index greater than 20 is often acknowledged to be indicative of significant scientific contributions to a particular field*". The core team members (Annex 3.7) are internationally recognized experts in their research fields and have proven track records in LWS R4D agenda. The Flagship co-leaders, Jennie Barron (IWMI) and Anthony Whitbread (ICRISAT) joined the CGIAR recently, each bringing over 20

years of R4D experience in LWS agro-ecological settings and accompanying experience on agricultural water management, crop nutrient and climate risk management with much of their previous work undertaken in CGIAR initiatives (CPWF) and phase 1 CRPs.

The partners in LWS have demonstrated capacity to deliver high-quality science and knowledge that will leverage investments and benefits for impact. The Phase 1 activities achieved impacts by leveraging new ALWM investments and policy changes that provided significant returns on investment (RoI = 6:1). For example, WLE research and policy dialogues facilitated policy changes in West Bengal, India, that enabled farmers to expand use of groundwater from annually recharged aquifers in blocks with abundant groundwater resources. The policy changes resulted in over 140,000 new electric connections for tube wells, which improved irrigation on 250,000 ha for approximately 1.3 million mostly smallholder water users. This led to greater net returns due to reduced production costs, improved water quality and enabled higher-value outputs. Research findings from the AgWater Solutions initiative[22] have directly influenced over USD 22 million in new R4D investments by donors and governments,[23] prompted new policies that have expanded access to sustainable groundwater supplies for hundreds of thousands of smallholder farmers, and fostered cross-sectoral policy synergies promoting more efficient and sustainable use of natural resources. The AgWater Solutions initiative has also influenced the Government of India's investment of USD 67 million in WLE's recommended solar power promotion program (Giordano et al. 2012; Hirvonen 2013).

LWS will take **proactive steps to further enhance scientific quality** to strengthen the LWS flagship and WLE credibility. This will include: 1) mentoring of younger researchers and support for rigor in scientific approaches and protocols; 2) ensuring strategic partnerships with prominent external research groups complementing with new methods and data relevant to the LWS agenda; and 3) support for publications in highly ranked journals and conferences with relevant topical focus.

LWS research will comply with each CGIAR partner's policy on ethics in research. At a minimum, this will require researchers to adopt codes of conduct for best practices, respecting the principles of integrity, excellence in research, safety and well-being, and respect for persons and ecosystems (e.g. IWMI Research Ethics Policy 2015).

2.2.1.5 Lessons learned and unintended consequences

In Phase I, LWP's R4D portfolio leveraged new investments by IFIs, donors and governments, promoted new policies to expand access to sustainable groundwater supplies, and fostered cross-sectoral policy synergies promoting more efficient and sustainable use of natural resources. The main factors contributing to these achievements were: 1) demand-driven research evidence testing ALWM interventions – their suitability, potential and impacts – within broader socioeconomic, biophysical and policy landscapes was provided to boundary partners that could act on it; and 2) regular dialogue and

[22] The AgWater Solutions project (2009-2012) website http://awm-solutions.iwmi.org/publications-1.aspx.

[23] This work directly influenced donor and government investments, including: 1) Small-Scale Irrigation Technologies and AWM Practices Program Strategy (USAID, 5 years, USD 12.5 million; 2) Turning Tragedy into Opportunity: Water Management Solutions in Nigeria (Government of Nigeria, 3 years, USD 2.1 million); 3) Opportunities to Enhance Smallholder Agriculture in SSA (IFAD, 3 years, USD 2.2 million); and 4) project research influenced the Government of Tanzania's decision to increase national investment in agriculture by USD 6 million.

engagement with primary boundary partners, including farmers, policymakers and investors to promote and accelerate positive change (Giordano et al. 2012; Hirvonen 2013).

Emerging from these achievements is a set of overarching lessons which have guided the development of LWS's Phase 2 proposal. These include the need for **impact assessment** to verify and strengthen WLE and flagships ToCs. Work is already underway to assess the impacts of Phase 1 policy outcomes. For example, an *ex-post* impact assessment of West Bengal's groundwater policy change, described above, is providing an early opportunity to assess impacts and propose modifications to the policy. In Phase 2, LWS will seek to assess research impacts of selected projects that have contributed to, or are part of, the current LWP flagship, including the Comprehensive Assessment of Water Management in Agriculture, the IWMI-Tata Water Policy Research Program, IWMI's work on large-scale irrigation in Asia, and the AgWater Solutions project, identified by SPIA (Merrey 2015) as promising and innovative for impact assessment. *Ex-ante* assessments are likewise needed, and in Phase 2, LWS will forge stronger linkages with the DCL, Livestock and Rice CRPs to undertake systemic assessments of sustainable intensification along value chains to build on the limited *ex-ante* environmental and ecosystems analysis to date. Reducing gendered barriers and building up capabilities also proved an important lesson for engagement of women.

LWP has also generated valuable lessons on how to **combine research and engagement for development outcomes** through, for example, the formation of outcome-oriented research teams, partnering to bridge research and uptake actions, and planning for long-term outcomes and impact goals.[24] Collaboration to develop stronger synergies with the AFS CRPs and the integrating CRPs in Phase 2 will promote new partnerships, innovations and solutions across institutions, actors, scales and systems; and build on the successful dialogue and engagement models from WLE Phase 1 to catalyze and extend the flagship's reach and impact. Moreover, refocusing the research from focal regions to focal countries in alignment with CGCC ++ and + countries will allow for sustained shared engagement and dialogue with key research, development, public and private sector partners.

The above steps are not only important to strengthen LWS's R4D program, but also to mitigate unintended consequences. As described earlier (Section 2.2.1), if not well planned and managed, well-intended interventions to improve land and water productivity can result in unintended and long-term consequences, including greater socioeconomic and gender inequities and conflicts, resource degradation and ecosystem deterioration, and increased costs and risks for farmers and society. Building on the lessons and experiences in Phase 1, a greater focus in Phase 2 on ***ex-ante* and *ex-post* impact assessment**, supported by the development of diagnostic analytical and monitoring tools**,** and **strategic partnerships and dialogue** will position the Flagship to better assess and monitor the implications of ALWM investment scenarios and mitigate possible unintended risks and consequences.

2.2.1.6 Clusters of Activity (CoA)

Cluster of Activities 2.1 ALWM Solutions for Resilient Smallholder Livelihood and Landscape Systems (IWMI and ICRISAT co-lead)

Partners*:*

Discovery/upstream	Proof of concept/pilot	Scaling out (downstream)
CGIAR: ICARDA, ICRISAT, IFPRI, ILRI, IWMI AFS CRPs: DCL, Livestock	Landscape/watershed/community/farmer organizations	AfDB, ADB, IFAD, World Bank, USAID, FAO, UNEP, GWP, national

[24] AgWater Solutions – Lessons Learned.

Discovery/upstream	Proof of concept/pilot	Scaling out (downstream)
Integrating CRPs: PIM, CCAFS Non-CGIAR: NARES, universities, national governments and implementing departments	NARES, water management/irrigation departments IFAD, FAO	governments, regional bodies, e.g. ECOWAS SADC, EAC, IGAD

Geographical focus

Countries	Regions	Global?
Ethiopia, **Ghana**, **India** Burkina Faso, Mali, Nepal, Niger, Tanzania, Zimbabwe	WLE II focal countries in West, East and southern Africa South Asia; and co-location of research with AFS CRPs (e.g. Ganges and Mekong deltas; dryland systems in sub-Saharan Africa and South Asia)	Yes

Notes: **Bold** = primary country

Soil, land and water management present fundamental challenges to sustainable intensification of agricultural landscapes, including cultivation of food crops, mixed crop-livestock systems, and pure livestock production systems. Achieving sustainable intensification involves more than the replication of AFS technologies at farm scale. It requires understanding how multiple ALWM interventions (technologies, practices, policies) fit into biophysical and social systems of agro-ecological landscapes as a basis to improve synergies and reduce trade-offs. It also requires understanding the complex social-ecological systems of smallholder farmers in landscapes, and the incentives, social-technical mechanisms, and policy contexts that enable levers of change at multiple scales (e.g. Karpozouglou and Barron 2014).

A range of "levers of change" is available to foster ALWM benefits at scale for smallholder farmers (Enfors 2013; Sendzimir et al. 2011), including enabling the engagement of women and youth. While islands of success exist (e.g. Pretty et al. 2006; Barron 2014; de Fraiture and Giordano 2014), knowledge of how to drive desired transformative changes through ALWM to create greater resilience in productive agro-ecological landscapes remains a complex challenge. This may be further exacerbated by climate change. **CoA 2.1 addresses the challenges of taking ALWM technologies to scale in irrigated and rainfed systems. The research will devise how communities and institutions implementing and investing in ALWM can sustain and benefit from such improvements at a landscape scale through enabling policy measures, improved investments and capacity strengthening.** CoA 2.1 will develop scientific understanding, including new information about policy measures and investment opportunities, to take sustainable ALWM innovations to scale to transform smallholder farming. This activity cluster builds on previous multi-scale efforts to translate ALWM innovations into use,[25] with new knowledge on how to create and promote context-specific development policies and investment decisions.

Research questions:

- What are the entry points and incentives for investing in ALWM (including technologies, social-economies, institutional, financial, and behavioral factors, policies) that will result in higher agro-ecological productivity, resilience and greater returns (food, nutrition, income and ecological benefits) at the landscape scale?

[25] AgWater Solutions, CPWF and innovations in value chains Africa Rising.

- What are the synergies and trade-offs related to ALWM interventions at scale in the landscape and their cumulative impacts, also at higher scales, with respect to the broader social, institutional, policy, and biophysical environment in which they operate?
- Which indicators are the most appropriate for assessing quantitative and qualitative changes in access, for both women and men farmers, to ALWM opportunities and related costs and benefits at landscape scale?
- How can institutional arrangements, collective action and capacities be developed to catalyze effective incentives to manage risks, trade-offs and promote regulatory compliance enhancing equitable distribution of sustainable benefits through ALWM?
- How can women and youth be empowered to use and benefit from ALWM and productive use of water and land in landscapes?

Theory of change and impact pathways:
LWS aims to influence investment decisions to enable ALWM for smallholder farmers together with ESA in selected focal countries - Ethiopia, Ghana and India, with additional countries based on bilateral funding streams. It will build on WLE's innovative engagement processes (Section 2.2.4) with policymakers, IFIs, NGOs, universities and the private sector (including farmers). CoA 2.1 contributes to the evidence base on how to achieve rapid transformation in agro-ecological landscapes based on best knowledge to ensure development and sustainability targets are met. Co-design of R4D through an iterative dialogue process with partners will enable CoA 2.1 to respond to boundary partners' needs and increases likelihood that new knowledge is applied.

LWS will build on existing, and form new, strategic partnerships for different stages of the R4D along the impact pathways. LWS will undertake: 1) **joint research** with discovery and upstream partners (including fieldwork, development of methodologies and tools) with AFS CRPs and ICRPs, universities and NGOs to assess the actual and potential social and environmental opportunities and impacts of system intensification and promising solutions; 2) **regular dialogue** with IFIs, policy partners and decision makers to link with national priorities and strategies, in order to influence investments and national, regional and global discourse contributing to policy formulation; and 3) **capacity development at tertiary level and vocational training**[26] to enhance individual and institutional capacity.

Key outputs:
CoA 2.1 will create products informed by scientific knowledge tailored to the needs of partners and stakeholders, including: 1) **economic cases for investment** in sustainable and equitable ALWM out scaling (2018, 2020, 2022), policy-to-practice processes, including **incentive systems with specific entry points for women and youth (2020)**; 2) data, methods and **diagnostic and systems analytical tools** to assess and monitor adoption and benefits to the environment and well-being; and 3) **tertiary, vocational training and curriculum development**, **peer-reviewed scientific publications** and presentations to document and disseminate the research findings and lessons learned (ongoing 2017-2022).

LWS Outcomes (*Table 2.2.1*):
LWS *Outcome 2.1*: in at least four country level initiatives in ALWM development and investments informed by LWS research. Contribution to LWS Outcome 2.2: adoption of sustainability considerations and management improvements in ALWM investments affecting at least 5 Mha, coordinated with WLE flagships RDL, ESA and VCR, and AFS Livestock, CCAFS and DCL.

[26] LWP assisted UNESCO-IHE curriculum development and supervision of Nile basin MSc and PhD students.

***Cluster of Activities 2.2 Unlocking Values in Irrigation Systems (IWMI and ICARDA co-lead*)**

Partners

Discovery/upstream	Proof of concept/pilot	Scaling out (downstream)
CGIAR: Bioversity, ICARDA, ICRISAT, IWMI CRPs: DCL, RICE Non-CGIAR: NARES (ICAR, PARC); universities, irrigation agencies, WUAs	Irrigation agencies and WUAs; ICID, FAO, IFIs	National governments, IFIs, FAO, UNDP, bilaterals

Geographical focus:

Countries	Regions	Global?
Egypt, Ethiopia, **India**, **Vietnam**, Ghana, Nigeria, Pakistan, Uzbekistan, Zimbabwe	WLE focal regions; co-location of research with AFS CRPs and other CGIAR projects	Yes

Notes: **Bold** = primary country

Large-scale irrigation systems (LSIS) in developing economies create primary production worth over USD 280 billion per annum (Lankford et al. 2016). Recognition of the water used by irrigation and the extent of irrigation-induced land degradation (e.g. salinity, waterlogging)[27] is creating renewed urgency to modernize irrigation services and performance.[28] **The major challenge is to produce more food, feed and fiber without substantial increases in natural resource (land and water) use, i.e. how irrigation will support sustainable intensification of food production** (FAO 2011). In Asia, irrigation is changing as farmers invest in pumps and wells to reduce exposure to poorly performing irrigation systems (Shah 2009). In Africa, irrigation remains underdeveloped. A renewed focus on better performing irrigation is evidenced by World Bank investments, e.g. "Sahel Irrigation Initiative" and "Transforming Irrigation in Nigeria"; and commitments by ADB to water-food-energy nexus issues (ADB 2012, 2013). Initiatives such as the *Prime Minister of India initiative for* "water to every farm" signal a renewed focus (Shah et al. 2016).

Degraded irrigated soils reduce production and this is likely to continue decreasing further over time. Secondary salinity is widespread in arid and semi-arid irrigated environments with estimates of over 20% of all irrigated lands being salt-affected. In Uzbekistan, 51% of 4.3 Mha is affected by some degree of salinity that yields of wheat and cotton have declined. A recent estimate of salt-affected lands in India is 141 Mha. Traditional reclamation techniques are costly and slow to return value to the farmers.

CoA 2.2 will work to transform performance of medium- to large-scale, publicly-managed, irrigation systems and to unlock **agro-ecosystem** services (WLE 2014), building on existing research outputs[29] and applying business-like approaches to transform delivery of irrigation services. The activities will include developing and testing innovative management approaches, including use of halophytes in severely affected lands and local drainage innovations for restoration of agricultural productivity of degraded

[27] Annually, salinization is estimated to remove about 1.6 Mha from production, reducing output by over USD11 billion each year. http://salinity.agwaterconsult.com/?opt=00.
[28] In Asia, irrigated agriculture will contribute 75% of increased food production (Turral et al. 2010).
[29] Water Accounting+; irrigation benchmarking tools; FAO MASCOTTE.

lands. Working with private sector actors (water user groups, agribusiness, and ICT providers) to address calls from national finance and planning agencies for more equitable and sustainable irrigation services (ISPC 2012), COA 2.2 will explore opportunities to engage youth in new service delivery business models.

Research questions:

- How can private sector business management and organizational change processes overcome inertia in irrigation service agencies? How can change management processes support gender equity in the irrigation sector?
- How can performance benchmarking drive change-management strategies in irrigation services? What technical and policy instruments are applicable to manage and mitigate problem soils (e.g. saline, acidic) at scale in irrigated systems?
- How can new business models (i.e. PPP) and market forces improve service delivery and cost-sharing in LSIS to increase social and economic benefits, sustainability, and minimize undesirable environmental and socio-economic impacts?
- How can ecosystem service objectives be built into irrigation management goals? What are the drivers of better soil management practices in irrigation systems? How can developments by AFS CRPs be translated into impact across systems and scales? What are the productivity, socioeconomic and environmental impacts at landscape scale?

Theory of change:
WLE works directly with policy makers, public sector agencies and investors to promote research-based solutions for irrigation management.[30] With the ESA Flagship, DCL and RICE CRPs and other partners, LWS will promote and extend the reach and uptake of technology and approaches to overcome institutional resistance to change.

Uptake partners:
Policymakers in ministries of agriculture, water resources, and finance; leaders and staff of irrigation and drainage service providers; FAO; ICID; universities; bilateral, IFIs and private sector investors.

Uptake pathways:
1) **research** with public and private sector actors on new approaches to irrigation modernization and organizational reform; 2) ongoing **policy dialogues** to change perceptions on the potential for better irrigation performance, support policy reforms and introduction of effective incentive structures; 3) **demonstration** of business change processes to improve irrigation service delivery; and d) **targeted capacity development and exchange programs** to create a cadre of irrigation operations and drainage professionals.

Impact pathway(s): With DCL and RICE, irrigation service providers and national research networks, CoA 2.2 will demonstrate enhanced management systems and incentives for irrigation services, and explore engagement with private sector actors to develop "*value chain pull*" as a means to drive adoption of recommended strategies. In collaboration with selected AFSs, LWS will test viable soil, water and cropping strategies for sustainable management of irrigated soils, including problem soils, to increase agricultural production and incomes for farmers and sustain ecosystem services. The outcomes will inform policy dialogues with national agencies, influencing investments by IFIs and others in irrigation modernization.

[30] In India, with solar power companies (SunEdison India and Tata Solar) and the Sir Ratan Tata Trust to test solar solutions. In Pakistan and Sri Lanka, partnerships with telecommunications firms to enhance access to information in LSIS.

Journal publications and international events will extend the research findings beyond participating organizations and partners.

Key outputs:
To address the needs of partners and stakeholders, including: improved **baseline and benchmark indicator systems** to improve irrigation performance, enhance gender equity and increase ecosystem services (2017); **management change processes demonstrated** on selected irrigation schemes in partnership with IFIs and national agencies (2019 onwards); **recommendations for reforms and institutional arrangements** to sustainably and equitably improve water productivity through improved delivery of irrigation services (2018 onwards); recommended strategies to increase halophyte cultivation for land restoration and increased income for resource-poor farmers; targeted **capacity development programs (**2019 onwards**)**; and **scientific publications** and conference presentations to document and disseminate the research findings and recommendations (2017 ongoing).

Outcomes:
1) improved performance on over 2.5 Mha of irrigated agro-ecosystems, with WUE improved by 5% through investments in modernization of infrastructure and organizations; 2) improved management of about 100,000 ha of saline irrigated soils; 3) capacity building in the management of over 2,500 irrigation agency staff; and 4) at least two IFIs use WLE recommendations in the design of over 250,000 ha of irrigation investments.

2.2.1.7 Partnerships

Within WLE, LWS will address issues of economic empowerment of women and men with support from **GID**; cooperate with **RDL** to address incentives for landscape-scale restoration and associated gains of WUE through soil management; collaborate with **RUL** on ALWM uptake in rural-urban food systems; and with **VCR** to examine basin-scale, cross-sectoral opportunities for, and impacts on, productivity gains under resource variability. Activities with **ESA** will strengthen engagement in WLE's integration sites and adapt these processes to other regions.

LWS's ToC (Section 2.2.3) and its associated impact pathway is based on existing strategic efforts to build alliances within WLE, and with CGIAR and external partners. LWS will create synergies for research on ALWM solutions through co-location of research in integration sites and countries, including India, Ethiopia, Ghana and Egypt. With **PIM** (Flagship 5: Inclusive Governance of Natural Resources), LWS will join research on land tenure constraints and contribute to a knowledge repository where LWS and others can share and access evidence-based tools, methods, and institutional solutions. With **DCL** (FP 4: Integrated Land, Water and Crop Management), we will develop multi-scale frameworks for natural resource restoration and enhanced adoption and assessment of ALWM solutions from field to landscape scale. **Livestock** (FP Livestock and Environment, FP Feeds and Forages) will complement efforts on sustainable intensification of livestock production using a value chain approach with ALWM for fodder. LWS with AFS Livestock will also develop system approaches to address synergies and trade-offs in land, water and biomass resource use at landscape scale. Through **CCAFS** (FP Climate-smart Agricultural Practices), we will collaborate on ALWM scaling effects and investment opportunities under various climate outlooks. **RICE** will co-develop approaches on irrigation for System of Rice Intensification (SRI), and develop methods to assess rice production agro-ecosystems.

The LWS impact pathways require a number of cross-sectoral partnerships from landscape-scale piloting and development of proof of concept interventions, to global-level contributions to dialogues and discourses. In each context, partners contribute and co-learn through jointly undertaken R4D (see *Table 2.2.3*). This interactive and iterative process ensures R4D is demand driven. In the initial **discovery phase**,

the partners are typically upstream researchers from universities, independent foundations (think tanks), national and regional research systems, and CGIAR centers and CRPs. The partner group of national and regional decision makers and policymakers are key in the **piloting and development of proof of concept stage**, and LWS has established links with ministries and technical departments in agriculture, water resources and irrigation, and planning commissions in each of the countries identified. **For scaling up**, partners are typically operating at different spatial scales for different purposes: for technical out-scaling and implementation, NGOs, extension services and occasionally private sector entities are key; whereas to create enabling conditions, the national and regional policymakers are the critical pathways to impact. IFIs and other funding agents are strategic partners in using LWS knowledge products to design investments for change processes at local and national level. Universities and training institutions contribute to scaling out by teaching new knowledge to next generation research leaders. LWS will operate with partners across the impact pathway discovery, proof of concept and scaling stages for common agendas to enhance the influence and knowledge transfer.

Table 2.2.3 LWS Existing and Planned Partnerships

Discovery *(Providing methods, tools, evidence/solutions, local insights and local leadership)*	**Proof of concept** *(Innovating, adapting, testing and using research)*	**Scaling up** *(Convening spaces for scaling up, funding, resources, training future generations)*
IWMI, ICRISAT, ICARDA, IFPRI, ILRI, FAO AFS CRPs: DCL, RICE, Livestock Integrating CRPs: PIM, CCAFS Universities: Texas A&M, UNESCO-IHE, Nebraska WFI, Ethiopia Bahir Dar, Arba Minch, Ghana UDSM, Tanzania SUA, India, Pakistan NARES and regional centers: Water Research Commissions (Ghana); and AGRHYMET Research networks, e.g. global natural resource modelling projects that support (AGMIP)	Individual farmers, NGOS/CBOs - iDE, CARE, PRACTICA, Conservation Alliance, farm Africa Policymakers/decision makers at sub–national/national–regional scale in public sector, including extension services, planning commissions, irrigation departments Collaborations on global discourse in development (UNEP, FAO, UNCCD)	Investors: donors, ministries, IFIs (IFAD, ADB, AfDB, WB) Basin organizations: VBA, NBI, Private sector enterprises: supply of ALWM, and demand of produce Development agents and practitioners: local and central governments, NGOs, CBOs Global conveners of development; FAO, UNEP, UNCCD Universities and institutions in target countries

2.2.1.8 Climate change

In most of the agro-ecologies where LWS works, climate variability is the new normal (e.g. Hansen et al. 2012). Greater climate variability and strong indications of further climate change will affect opportunities, design and impacts of ALWM, including irrigation systems, at the landscape scale. The major climate change processes likely to affect landscape-scale ALWM actions and investment choices include the following:

1. Increasing temperature and frequent heat events negatively impact on yields (Schlenker and Roberts 2009), and thereby land and water productivity. Improved ALWM holds some of the most promising and necessary climate change adaptation strategies in agro-ecological landscapes.

2. Increasing rainfall variability and frequency of extreme events (droughts, floods, etc.) demands enhanced out scaling of ALWM and new knowledge for management of investments to enable landscapes to sustain productivity and cope with potentially devastating events (e.g. high rainfall leading to erosion).

LWS will contribute to creating ***enhanced capacity to deal with climate extremes*** (sub-IDO A1.4) through ALWM actions that incorporate climate variability into analysis of return on investments. Further, the new norm of extreme events, in particular, floods and droughts, affecting water access, will be addressed by research on design considerations for new investments and upgrading of irrigation. LWS will further contribute towards the understanding of small, medium and large water storage options, investment needs, and generation of benefits across social and ecological dimensions in landscapes. In respect to managing climate and designing appropriate interventions at a landscape level, a key connection is with CCAFS, particularly Flagships 2 (Adaption planning at local and national levels) and 4 (Early warning and response integrated in national agencies). Further, policy-related work under CCAFS Flagship 1 (Improved policy framework for climate-smart food systems) will be connected.

2.2.1.9 Gender

Women face specific, multiple constraints that limit their access to improved ALWM practices and technologies. These include capabilities and competencies; lack of access to credit, and/or high upfront investment costs; exclusion from decision-making processes; and unfavorable land-tenure arrangements. Inadequate access to information that would enable better informed investments and management decisions constrains them. It is emerging that the burden of labor can increase significantly as an unintended effect of ALWM. Further research is needed on constraints faced by women, and the means to effectively remove these barriers and build capabilities to improve agricultural productivity and support broader development outcomes (Doss 2014; Domenech 2015).[31] Building on WLE Phase 1, PIM and AFS CRP research, and with GID support, LWS will explore opportunities to increase economic empowerment, of women, from improved land and water productivity gains through system intensification to contribute ***technologies to reduce women's labor and energy expenditure (sub-IDO B.1.2)***. LES will work with GID on barriers facing women and how to overcome them, i.e. gender power relations and gender capacities needed to allow women to benefit from ALWM and other solutions. LWS will address how higher returns can be gained by tailoring agricultural technologies and policies to meet the specific needs of women, and will develop innovative pathways and investment options to catalyze gender equity in transformation of agro-ecological landscapes.

Research efforts to understand the potential roles of youth in next generation agro-ecological landscapes will be part of the LWS agenda. LWS will develop its work on youth over time, in line with the youth strategy being developed, emphasizing overcoming the barriers, and what is needed to facilitate their becoming active stakeholders in land and water management.

2.2.1.10 Capacity development

Building on Phase 1 dialogue processes, LWS will engage with stakeholders to improve the quality of research and acceptance and application of research results to enable ***increased capacity for innovation (sub-IDO D.1.4)***. Farmers (men and women) and resource managers will help identify, plan and implement research to develop learning materials, tools and approaches for improved decisions and actions that enable multidimensional benefits of more productive use of land and water resources.

[31] See www.pim.cgiar.org/2014/10/06/how-much-food-do-women-produce/.

Collaboration with AFS CRPs in CGIAR integration sites, training of farmers, extension and local stakeholders will be implemented in ALWM practices in Ethiopia, India, and Ghana. Partnerships with **universities and training centers** will develop future research leaders and strengthen capacity for ALWM innovation by: 1) integrating methodologies, tools and products into curricula; 2) supervision of postgraduates; and 3) hosting interns and visiting researchers. Successful R4D collaborations are in place with UNESCO-IHE and Bahir Dar University, Ethiopia, supporting inclusion of ALWM in curricula for undergraduates. **Public and private sector partners** (investors, service providers, system managers) will be engaged in the R4D process by regular interactions and mutual learning to enhance organizational development, innovation capacity, and to create awareness of and ownership for ALWM innovations to reinforce pathways of change. **Policymakers** in national and sub-national agriculture, land and water resources agencies will be engaged in setting research priorities and generating outputs. Results will be presented in formats that support science-informed policy and investment decisions. A special effort will be to assess capacity development needs of new generation expertise in ALWM, including for irrigation systems, to inform future investments. A particular focus on enabling equal opportunities in capacity development to offer opportunities to underrepresented sexes will be promoted. *Table 2.2.4* shows the CapDev elements prioritized by LWS.

Table 2.2.4 CGIAR Capacity Development Elements Addressed by LWS (darker shading = more focus)

Element	LWS CoA 2.1	LWS CoA 2.2
Needs assessments and intervention strategy		
Learning materials and approaches		
Developing CRPs' and centers' partnering capacity		
Develop future research leaders		
Gender-sensitive approaches		
Institutional strengthening		
Monitoring and evaluation		
Organizational development		
Research on capacity development		
Capacity to innovate		
Key:	High	Medium

2.2.1.11 Intellectual asset and open access management

LWS research outputs and products will be managed in line with the CGIAR Principles on the Management of Intellectual Assets and their Implementation Guidelines. All LWS research results and products will be developed as International Public Goods, to maximize the impact of such products, in a manner that fosters achieving the CGIAR SLOs. All datasets, applications and tools developed are being published and made available online. IWMI hosts a large open information portal focusing on larger-scale thematic datasets, tools and models' setup. LWS is a contributor to this open access system. Another key dissemination pathway of the LWS outputs is publications. The LWS ambition is to have open access close to 100% by the start of the WLE Phase 2 in January 2017. LWS partners will be supported to commit to

the CGIAR Principles on the Management of Intellectual Assets and the CGIAR Open Access and Data Management Policy. This will be ensured, amongst others, through contractual agreements. Budget support for continuous increase of open access publishing will be factored into joint proposals. Two challenges may emerge depending on particular activities and funders. First, the use of data or products under third-party property rights can be addressed through appropriate contractual agreements. Second, on occasions, partners request non-disclosure agreements for certain funding. Such situations have to be addressed case-by-case, depending on activity, data and information to be developed.

2.2.1.12 Flagship management

Flagship management will be subject to WLE's results-based management (RBM) strategy (see Annex 3.5), which outlines options for performance-based allocations and monitoring, non-financial incentives, reporting, evaluation, etc. LWS leadership will be appointed by IWMI based on activity and resource contribution to the LWS portfolio. The two Lead Centers – IWMI and ICRISAT – will share the program management. A co-leader from each of these two centers will coordinate Flagship leadership tasks. They are responsible for driving the flagship strategy and achieving its plans within the boundaries the W1/2 allocation supports. Within the LWS Flagship, IWMI, ICRISAT and partners ILRI, ICARDA and FAO will share core team reporting, planning and representation responsibilities for the Activity Clusters, including advice on outreach and uptake. Regular virtual meetings will keep the core partners aligned. The Flagship will be represented in the WLE MC through its leaders. Flagship management will be subject to the proposed CRP performance assessment framework and Performance Monitoring Plan.

2.2.2 Flagship Budget Narrative

2.2.2.1 General Information

CRP Name	Water, Land and Ecosystems
CRP Lead Center	IWMI
Flagship Name	FP 2: Land and Water Solutions for Sustainable Intensification (LWS)
Center location of Flagship Leader	IWMI & ICRISAT

2.2.2.2 Summary

Table 2.2.5 Flagship Budget Details

Total Flagship budget summary by sources of funding (USD)

Funding Needed	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	1,834,337	1,926,054	2,022,357	2,123,475	2,229,649	2,341,131	12,477,003
W3	0	0	0	0	0	0	0
Bilateral	8,613,519	9,044,195	9,496,405	10,446,045	11,490,650	12,639,715	61,730,528
Other Sources	0	0	0	0	0	0	0
	10,447,855	10,970,248	11,518,761	12,569,519	13,720,297	14,980,845	74,207,525

Funding Secured	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Assumed Secured)	1,834,337	1,926,054	2,022,357	2,123,475	2,229,649	2,341,131	12,477,003
W3	0	0	0	0	0	0	0
Bilateral	1,891,235	657,977	192,115	11,930	0	0	2,753,257
Other Sources	0	0	0	0	0	0	0
	3,725,571	2,584,031	2,214,471	2,135,404	2,229,648	2,341,131	15,230,256

Funding Gap	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Required from SO)	0	0	0	0	0	0	0
W3 (Required from FC Members)	0	0	0	0	0	0	0
Bilateral (Fundraising)	-6,722,284	-8,386,218	-9,304,290	-10,434,115	-11,490,650	-12,639,715	-58,977,271
Other Sources (Fundraising)	0	0	0	0	0	0	0
	-6,722,284	-8,386,218	-9,304,290	-10,434,115	-11,490,650	-12,639,715	-58,977,271

Total Flagship budget by Natural Classifications (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
Personnel	2,902,765	3,053,549	3,211,119	3,498,923	3,814,693	4,162,304	20,643,356
Travel	588,762	617,951	649,201	710,201	777,516	849,911	4,193,543
Capital Equipment	65,530	68,807	73,254	80,019	87,224	95,965	470,802
Other Supplies and Services	2,439,737	2,556,507	2,677,885	2,914,637	3,174,356	3,456,653	17,219,778
CGIAR collaborations	981,449	1,030,323	1,082,041	1,182,468	1,290,301	1,409,654	6,976,237
Non CGIAR Collaborations	2,226,128	2,337,431	2,454,277	2,687,476	2,943,492	3,223,766	15,872,573
Indirect Cost	1,243,482	1,305,678	1,370,981	1,495,792	1,632,713	1,782,589	8,831,238
	10,447,853	10,970,246	11,518,758	12,569,516	13,720,295	14,980,842	74,207,510

Total Flagship budget by participating partners (signed PPAs) (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
IWMI	5,297,716	5,562,602	5,840,732	6,375,566	6,961,423	7,603,280	37,641,320
ICRISAT	2,448,283	2,570,697	2,699,232	2,946,400	3,217,148	3,513,775	17,395,538
IFPRI	1,410,833	1,481,375	1,555,444	1,697,876	1,853,896	2,024,828	10,024,254
Tier 2 Partners	1,203,470	1,263,644	1,326,826	1,448,323	1,581,412	1,727,220	8,550,898
IWMI - WLE	87,551	91,929	96,525	101,351	106,420	111,740	595,518
	10,447,853	10,970,247	11,518,759	12,569,516	13,720,296	14,980,843	74,207,514

LWS W1/W2 funds will support the research for development (R4D) agenda to guide public and private sector investments in, and policy development for, sustainable management of resilient rainfed, small-, medium- and large-scale agricultural land and water management (ALWM), including irrigation development in Africa and South Asia to enhance land and water productivity and incomes. R4D involves multiple partnerships and assumes continuous realization of 80% of bilateral funding to enable achieving anticipated outcomes and impact targets. Key flagship deliverables include: 1) baseline data and benchmarking of the extent of ALWM out-scaling and impacts to date; 2) *ex ante* analysis of resilient food systems and sustainable intensification; 3) development of evidence-based, context-specific investment options for ALWM solutions that inform policy and investments; and 4) enhanced understanding of institutional arrangements, capacity building and incentive systems, especially for empowering women and enabling participation of youth. Approximately 75% of the LWS budget will be allocated to CoA 2.1 "ALWM solutions for resilient smallholder livelihood and landscape systems" and 25% to CoA 2.2 "Unlocking values in irrigation systems". The regional distribution of W1-W2 funds is estimated as 40% in South Asian priority countries, 40% in sub-Saharan African priority countries, and 20% contributing to globally relevant agendas. Bilateral funding may change overall LWS budget shares depending on emerging opportunities and partnerships during 2017-2022.

LWS funds will be allocated for research activities, communications and support staff salaries constituting 28%, with associated travel of 6% for research collaboration and communication to enable pathways to impact. About 30% of the total budget will be to enable partnerships, with 9% for collaborative actions with AFS CRPs and CGIAR centers beyond WLE. The share of 21% for external partners will enable LWS to work with partners along its impact pathways in key countries.

The main risk to the expenditure plans is the limited knowledge available at this early stage of the funding landscape over the next six years. To mitigate budget risks, LWS proactively engages in funding strategies outlined below in Section 2.2.2.3. These include, inter alia: 1) delivery of high-quality research to maintain reputation and recognition, enabling translation into use by target boundary partners; 2) strengthening existing and developing new strategic partnerships in R4D at national and regional level to promote engagement with IFIs; and 3) developing previously untested funding sources, including private sector-corporate partnerships, and independent foundations for social and environmental development. The W1/W2 and bilateral funding in the budget is based on current best estimates. Funding availability will almost certainly deviate from these estimates, affecting the activities that the Flagship is able to complete and the corresponding allocation of funds. WLE is putting in place a results-based management system which will include performance-based funding allocation, which may result in changes in budget allocations by partner (given in the third summary table) in the course of the program.

2.2.2.3 Additional explanations for certain accounting categories

The components of benefits are: home leave, pension, vehicles, housing, educational allowance, and health insurance. Each center working as part of this program has clear policies and procedures with regards to each of the above cost components, which may differ from center to center and category of employment (national, regional, international, etc.). The policies vary among partner centers and are based on local laws and needs.

The supplies and services are budgeted as per the costing principles laid out in CGIAR Financial Guidelines 5 issued by the Consortium Office.

The cost can be broadly categorized into two categories:

1. Research Support and Quality and Coordination costs: Services or research support costs for a CGIAR center include research oversight, facilities (or occupancy costs) and general services such as rent, utilities, IT, phone/fax, etc. Other costs include project oversight, data management and depository, and output quality control which are not fully charged on common budget lines.
2. The calculation of charge out rates is based on CGIAR Financial Guidelines 5, whereby costs that are not directly research related are treated as research support. The cost of the services is allocated to benefiting projects based on utilization of these services by research staff. Utilization is measured by the number of direct labor hours incurred by research staff while providing direct research support under each project.

The direct costs include consulting services, professional services, publications or subscriptions, conferences/workshops, communications, postage and other miscellaneous costs which are essential for providing the resources to conduct the planned activities and achieve the targeted outcomes. The estimation of the costs has been determined using the phase 1 costs as a baseline.

2.2.2.4 Other sources of funding for this project

LWS will seek additional funding through multiple sources in partnerships for research for development. The potential sources are a diverse set of funders, and modes of sourcing, including open calls in research, R4D open and closed call by IFIs, foundations and governments. Collaboration with the private sector will be further explored to broaden the funding base.

LWS will continue to explore alternative financing with international and national development foundations, increased collaboration with private sector corporate social responsibility programs; and national development investment programs. However, these organizations are often focused on development finance and thus may restrict opportunities for some of the research activities planned. Research and R4D priorities will be set in the core partnerships of LWS together with WLE, assessing: 1) risks and opportunities in achieving research outcomes and impact in locations and topics of LWS, and 2) relative cost-effectiveness (rate of return) between options. Research investments that are likely to leverage follow-on funding will be prioritized. Priority countries in the respective CoAs will be as outlined in the proposal (CoA 2.1: Ethiopia, Ghana, India and CoA 2.2: India, Egypt, Ethiopia and Vietnam) with further activities proposed, pending additional funding and collaborative opportunities, in Burkina Faso, Mali, Niger, Nigeria, Pakistan Tanzania, and Zimbabwe. The uplift budget would also include Uzbekistan as a priority 2 country.

2.2.2.5 Budgeted costs for certain key activities

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
Gender	126,0000	A total of 10-12% is dedicated to gender-related R4D to attain the 2022 target of at least 33% of target beneficiaries being empowered female-headed household or female ALWM practitioners (Annex 3.3: Gender). Specific efforts in CoAs 2.1 and 2.2 will implement research that: 1) addresses barriers to women's equal opportunities in accessing and realizing ALWM technologies and solutions, and 2) clarifies how

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		enabling equal opportunities for women enhances sustainable intensification in transforming agro-ecological landscapes. Further, funding will support the evidence–based tools for decision and investments support on how gender and equal opportunity for women and men can be attained across medium and large-scale investments in irrigation. Such tools have been piloted under WLE Phase 1 with demand driven application in Uzbekistan. In studies of gender-enhancing efforts, concerns about need of behavioral and cultural change is emerging as a main barrier for adoption and realization of smallholder irrigation in Innovation Labs for Small-Scale irrigation (ILSSI). However, through gender-sensitive design, ALWM can provide multiple benefits to men and women, but with higher labor-saving benefits for women. These gender aspects will be advanced under LWS, including through special emphasis on gender sensitive approaches into CapDev activities. The Flagship, with the help of GID and encompassing these planned activities, will develop a multi-year gender plan, with a dedicated gender budget.
Youth (only for those who have relevant set of activities in this area)	630,000	LWS research will seek to understand the roles and opportunities for of youth as the next generation of managers of agro-ecological landscapes. Age has been shown to be an important determinant of change in behaviors and investments into farm enterprises. LWS allocates between 5 and 10% of its budget to addressing youth issues, especially how to provide viable and profitable livelihood options in ALWM and irrigation, whilst sustaining the natural capital it relies on. Specific research efforts will be on understanding the aspirations, and developing the capacities, of young men and women in relation to ALWM and irrigation of today and the future: what roles do youth perceive they can play and desire to play? What technologies and mechanisms do youth expect for improving ALWM and irrigation? (see Annex 3.4: Youth Strategy). Specific CapDev efforts will be directed to building the next generation of managers and irrigation expertise to ensure economically viable and environmentally sustainable irrigated food production systems in Sub-Sahara Africa and South Asia
Capacity development	1,491,000	Approximately 10 -15% of the LWS budget and activities will be invested in CapDev. The main components envisaged include: identifying and contributing to meeting capacity gaps, development of innovative learning materials (curriculum for tertiary and technical up-skilling), integrating gender-responsive and targeted approaches, and supporting the capacity to innovate. The emphasis is on curricula development and vocational training in CoA 2.1 and CoA 2.2, and supporting individual and institutional development and strengthening

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		across LWS. One effort in curricula development will be integrating subjects that were often ignored in the past, including new knowledge on participatory and gender-inclusive approaches to ALWM and irrigation development, as well as targeted biophysical, agronomic and engineering issues. This contributes to creating the capacities needed in both current and future generations of technical experts, from planners to extension agents. The extension services of many African countries is aging/ retiring and many countries have increased emphasis on agriculture commercialization for food security and economic development. Examples of LWS investments in CapDev include continuing the LWS collaboration with UNESCO -IHE for joint curricula development with Ethiopian universities to strengthen current and next generation ALWM and irrigation expertise, as that country improves it vocational-technical education in irrigation and agricultural sciences. In Nepal, India and Pakistan, LWS invests bilateral funding in support for vocational training modules for institutional strengthening of public sector irrigation development, including introducing gender responsive approaches to multiple uses of water alongside ALWM and irrigation. In addition, LWS will continue to support individual men and women researchers and technical staff in R4D activities through internships, MSc and PhD researchers, and visiting scientists with priority to underrepresented candidates and countries.
Impact assessment	189,000	Basic impact assessments will be built into the program management to monitor progress towards program objectives. In addition, the following studies are planned (see Annex 3.5: Result Based Management): Bill and Melinda Gates Foundation funded AgWater Solutions five years' *ex post* evaluation (Ethiopia, Tanzania, West Bengal and Madhya Pradesh (India), Burkina Faso, Zambia); USAID–funded ILSSI (Ethiopia, Tanzania, Ghana in 2017); MUS developments in Nepal; and Tata Foundation funded evaluation of solar pumps on agricultural and environmental outcomes in Rajasthan, India. Impact assessments will be financed through a variety of mechanisms, including individual project budgets for impact assessment as per donor requirements, and through dedicated sourcing of *ex-post* evaluation through open or closed calls. In addition, to support impact assessment of LWS, we will establish a LWS project for baseline data collection and impact assessment work relevant to LWS. The budget for impact assessment is included in Monitoring, Evaluation, Impact Assessment and Learning (MEL), including approximately 10% of Flagship Leaders' and 5% of Project Leaders' time will be allocated, including reporting and oversight. The other MEL costs in this Flagship budget are baseline,

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		sampling, data collection and follow-up. These are incorporated into the lines on travel, supplies and services.
Intellectual asset management	243,600	Compliance with the CGIAR Principles on the Management of Intellectual Assets is task of each WLE partner Center and backstopped by the Lead Center Legal officer and Business Development Director, and the cost is part of supplies and services. This process will be supported by the CRP management at CRP level.
Open access and data management	105,000	Compliance with the CGIAR Open Access and Data Management Policy is a task of each WLE partner Center, and not funded by individual flagships. However, this Flagship will encourage research proposals to include resources to cover OA/OD, like open access fees for articles, database membership fees, server and hardware costs, and ensuring data quality assurance. Staffing costs will be covered by a combination of personnel costs and supplies and services. LWS will disseminate its research through the WLE website, blog and solutions platforms.
Communication	630,000	An estimated 10% of resources required for Knowledge Management and Communication (KMC) is included in each LWS projects, funded by W1/2 or bilateral sources. LWS knowledge products will include materials for use in development processes, such as participatory videos, press releases, radio and TV interviews, policy briefs, blog pieces, decision support systems, and academic books and papers. It will also include engaging with stakeholders, including participating in policy level discussions and engaging in key events at the national, regional and global levels. As the focus on KMC at flagship level is on communicating and engaging stakeholders, WLE KMC will involve uptake/ communication staff based in participating Centers leading LWS. The Flagship will also work closely with program level KMC on strategic communications planning and implementation.

2.2.2.6 Other

The indirect costs in this budget include: costs for support service units such as HR, finance, administration, etc. In case there is a sudden decrease of funding, indirect costs will remain at a higher rate as it will take time to make adjustments. The indirect cost rate is based on CGIAR Financial Guidelines 5.

The highest risks to this program is instability of funding and increase of costs due to change in external and internal environments. The program team under the leadership of the Lead Center will review the risks on a quarterly basis and ensure that budgetary adjustments are tracked due to these risks.

The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the bilateral projects mentioned in this budget will be approved without any variance. Partnerships are largely supported through bilateral funding, which reduces the systemic risk from fluctuations in windows funding.

Inflation is considered in the costs at 2.63%, which is based on the average IMF projections for the next six years. The major costs are incurred in USD and therefore the risk in foreign currency exposure is insignificant.

2.2.3 Flagship Uplift Budget

Outcome Description	Amount Needed	W1 + W2 (%)	W3 (%)	Bilateral (%)	Other (%)
Outcome 2.3: Adoption of ALWM solutions benefit additional 1.5 million beneficiaries in WLE and AFS-CRP landscapes	9,711,500	50	0	50	0
Outcome 2.4: Increased water use efficiency and water productivity by an average of 5% in targeted ALWM and irrigation systems in Africa and South Asia on a further 2 million ha	15,273,500	50	0	50	0
Outcome 2.5: Improved management of irrigated problem soils enables reclamation of about 0.5 million ha	5,562,000	50	0	50	0

2.3 WLE Flagship 3: Sustaining Rural-Urban Linkages (RUL)[32]

2.3.1 Flagship Narrative

2.3.1.1 Rationale and scope

Lead center: IWMI (research); **Co-Lead:** Resource Center on Urban Agriculture and Food Security (RUAF) Foundation (piloting, uptake); **Advisor:** UN-Habitat (uptake)
Partner Centers: CIAT ICRAF), Bioversity, ICARDA, ILRI, WorldFish, FAO

Research at landscape level must consider the strong influence of population patterns and dynamics, in particular urbanization, which is increasingly altering the connectivity of resources, energy, and information among social, physical, and biological systems (Grimm et al. 2008)[33]. With resource flows being more and more determined by urban demands, food security and poverty are no longer the only rural challenges (Reardon et al. 2014; Satterthwaite et al. 2010). Peri-urban areas, in particular, are hot spots for farming system transformation and intensification in view of urban demands, and also for resource degradation and depletion (Harding et al. 2015).

WLE will address these challenges and opportunities for natural resource management (NRM) at landscape level through its *Rural-urban Linkages (RUL) Flagship*. Building on the resource recovery and reuse (RRR) business models developed in Phase 1 of WLE, RUL's objectives in Phase 2 are to optimize their implementation, maximize urban food security, identify new business opportunities for young women and men, and minimize the footprint of urbanization on natural resources and ecosystem services.

Urbanization is the preeminent global phenomenon of our time. By 2050, about 66% of the global population of 9.7 billion is expected to be living in urban areas, including the majority of the poor. Today, these areas account for 75% of the world's natural resource consumption, while producing over 50% of the globe's waste on just 2-3% of the Earth's land surface (UNEP 2013). These pressures will continue to grow, especially in Africa where the population will more than double to 2.4 billion (Haub and Kaneda 2013). There is a growing international focus on rural-urban linkages and governance as reflected in the Sustainable Development Goals (SDGs), various donor programs, Habitat III, and initiatives by the International Council for Local Environmental Initiatives (ICLEI) and the Food and Agriculture Organization of the United Nations (FAO), including the Committee on World Food Security (CFS 2016).

The comparative advantage of the CGIAR to engage through WLE in rural-urban challenges builds on the combination of WLE's cross-sectoral landscape perspective, a decade of innovative research on urban and peri-urban agriculture (UPA), and closed loop processes by the International Water Management Institute (IWMI) and the International Center for Tropical Agriculture (CIAT), supported by the Resource Centers on Urban Agriculture and Food Security(RUAF) Foundation (e.g. De Zeeuw and Drechsel 2015), the former CGIAR-wide Urban Harvest Program (Prain et al.2010), and a range of others projects by FAO, World Agroforestry Centre (ICRAF), International Center for Agricultural Research in the Dry Areas (ICARDA), Center for International Forestry Research (CIFOR), and the International Food Policy Research Institute (IFPRI). Given the potential implications of urbanization for rural food production, and water, land and ecosystems, WLE proposes with RUL an interdisciplinary

[32] All acronyms are defined when first used and then summarized in Annex 3.14.
[33] All references are listed in Annex 3.15.

flagship that will use WLE's landscape approach to support the analysis of solutions and possible trade-offs across scales to 1) optimize resource allocations under multiple pressures, and 2) complement the more rural perspective of other flagships and CRPs to support collaborative rural-urban governance models (Berdegué et al. 2014; Tacoli 2006; McGregor et al. 2006). These will enable cities to look beyond their administrative boundary to address 'food security'.

While urbanization can be an opportunity for employment, new markets and business models to foster well-being and economic growth, including for men, women and the rural youth, in particular, it also comes with risks and challenges affecting our natural resource base. The environmental footprint left by urban consumption centers in many low- and middle-income countries is threatening the delivery of ecosystem services on which cities, their watersheds and urban food security depend. Urbanization is also one of the primary causes of land-use change, pollution, and habitat loss (Grimm et al. 2008). A recent WLE-IWMI study estimated that, globally, 456 Mha of farmland can be found within a 20-km radius of urban centers, which is an area about the size of the European Union (Thebo et al. 2014). The authors also showed that the ratio of irrigated farmland to rainfed production is especially high closest to the cities, reflecting strong intensification. This is often driven by the informal sector and results in hardly-managed trade-offs at landscape level, such as the challenges of inter-sectoral water competition, including surface water and groundwater overuse (Molle and Berkoff 2006; Foster and Vairavamoorthy 2013), food safety concerns due to poor sanitation and the use of marginal quality water for irrigation (Raschid-Sally and Jayakody 2008; Drechsel et al. 2010).

The RUL Flagship continues the work of the Resource Recovery and Reuse (RRR) Flagship of Phase 1 of WLE on opportunities and challenges for sustainable natural resource management under increasing urbanization. As a bridge between rural and urban stakeholders within jointly managed landscapes, the flagship delivers interdisciplinary, innovative research with the dual objectives of minimizing the footprint of urbanization on soils, water, livelihoods and ecosystem services, while increasing resource recovery and reuse efficiency for increased system resilience to future resource limitations (e.g. food price peaks, peak phosphorus), political instability and/or climate change (Birkmann et al. 2010; UNEP 2013; CFS 2016).

2.3.1.2 Objectives and targets

RUL solutions are offered through three interlinked Clusters of Activities (CoA) (*Figure 2.3.1*). The CoAs will address the following Grand Challenges outlined in the CGIAR Strategy and Results Framework (SRF): competition for land, and nutritious and diverse agri-food systems and diets (CoA 3.1), new entrepreneurial and job opportunities (CoA 3.2), and overdrawn and polluted water supplies and food safety (CoA 3.3).

Key partners for research and uptake in each CoA were selected on the basis of their reputation, quality of science and/or impact orientation, their responsiveness, and an expressed interest in contributing to the success of the Flagship.

Fig 3.1 RUL Clusters of Activities

With the objectives of maximizing urban food security and minimizing the footprint of urbanization on soils, water, livelihoods and ecosystem

services, the RUL Flagship will mostly support System-level Outcomes (SLOs) 2 and 3 and several sub-intermediate development outcomes (IDOs) (see *Table 2.3.1* and *Figure 2.3.1*). *Table 2.3.1* also shows key **outcome targets** set by the RUL Flagship in support of the SRF 2022 targets and the related annual budget forecast.

Table 2.3.1 Outcomes, Targets, Related IDOs and Projected Budgets (6-year base budget)

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	Outcome targets 2022 Targets	Budget (USD '000)
3.1	SLO 3; IDO 3.2.2: Agricultural systems diversified and intensified in ways that protect soils and water (SDG 2.4, 11a) Crosscutting IDO C.1.3: Conducive agricultural policy environment (SDG 11a)	Ethiopia, Ghana, Kenya, Uganda, Senegal, Zambia, Peru, Colombia, Vietnam, Sri Lanka, India	Increased capacity and evidence for stakeholders and policymakers to implement UPA-related policies and farming system innovations	Sustainable intensification with increased water- and nutrient-use efficiency supported on 4 Mha of urban and peri-urban irrigated and rainfed croplands	12,080
3.2	SLO 3; IDO 3.3.1: Increased resilience of agroecosystems and communities (SDG 6.4, 12.2 and 12.5) SLO 3; IDO 3.3.3: Reduced net greenhouse gas emissions (SDG 11.6)	Sri Lanka, India, Ghana, Kenya, Nepal, others	Increased business capacities in nutrient, water and energy recovery from domestic and agro-industrial waste for intensified (peri-) urban food production	Nutrient- and water-use efficiency increased on 3.6 Mha through resource recovery from food waste, returning via RRR of 10% of initial nitrogen (N), phosphorus (P) and potassium (K) applications In addition, 2 million tons carbon dioxide equivalent (tCO_2e) per year will be avoided through changes from landfilling to composting	16,000
3.2	SLO 2; IDO 2.3.1: Improved water quality (SDG 6.3, 12.4) SLO 3; IDO 3.1.1: Land, water and forest degradation minimized (SDG 15.3)	Sri Lanka, India, Ghana, Kenya, Nepal, Bangladesh	Increased public investments and adoption of WLE policy advice on fecal sludge management for ecosystem service protection	Investment strategies of five major international financial institutions (IFIs) and other donors refer to WLE. National guidelines change in over 9	16,000

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	Outcome targets 2022 Targets	Budget (USD '000)
				million rural households' management practices	
3.3	SLO 3; IDO 3.2.1: More productive and equitable management of natural resources (SDG 6.4, 6.5) Crosscutting IDO A.1.4: Enhanced capacity to deal with climate risks and extremes (SDG 6.3-6.5, 11b and 13.3)	India, Ghana, Egypt/Middle East and North Africa (MENA), Ethiopia, others	Improved institutional capacity for integrated urban water management (IUWM) and safe wastewater use in agriculture in three global regions	15 cities adopt IUWM to harmonize rural and urban water demands 0.5 million wastewater-using farm households understand safer irrigation practices	Uplift budget

The **first** and **second** outcomes will support the SRF target "to achieve a 5% increase in water- and nutrient-use efficiency in agroecosystems, including through recycling and reuse." The **first** outcome will build on the implementation of replicable models of technical solutions for agricultural intensification in land- and water-constrained urban and peri-urban farming systems, backed by policy support through RUAF in collaboration with United Cities and Local Governments (UCLG) and ICLEI - Local Governments for Sustainability, as well as FAO's Food for the Cities program. The **second** outcome will build on RUL's interdisciplinary work on business models, and technical and institutional solutions for nutrient and energy recovery from food waste and excreta, which offers multiple value proposition (creating a valuable product, reducing pollution and greenhouse gas [GHG] emissions). This contribution will also help to maintain non-renewable phosphorus in the system.

The solutions promoted through business models can, for example, recover up to half of the nutrients in fecal sludge collected from on-site sanitation systems and feed it back as fertilizer into the nutrient cycle. Capturing large amounts of organic waste before its decay on landfills and transforming it through composting into a soil ameliorant will also contribute to carbon sequestration. Another example is ICRAF's experiences on the development of varieties of fuel briquettes from organic waste suitable for domestic and industrial use (Njenga et al. 2013, 2014).

The **third** outcome in support of the sub-IDOs "to improve water quality" and "to minimize land and water degradation" relates closely to the impacts of poor sanitation on landscape health. For example, in India, it is estimated that 75-80% of water pollution (by volume) is from poor domestic sanitation (WaterAid 2016). WLE will continue its work on fecal sludge management guidelines in different parts of South Asia, which will potentially reach approximately 30 million households in urban India and 44 million households with on-site sanitation systems in rural India, and catalyze through IFIs working with WLE investments in RRR under their SDG support.

A **fourth** area of intervention, and one of the interfaces with the CGIAR Research Program on Agriculture for Nutrition and Health (A4NH), is WLE's work with the World Health Organization (WHO) and FAO on low-cost options and guidelines for safe wastewater irrigation. As the research arm of WHO, outreach will be achieved, as in the past (see next section), through WLE's contributions to

international guidelines and public goods, for example, farmer field school manuals. This could benefit approximately 50 million irrigating farmers in sub-Saharan Africa (SSA), Middle East and North Africa (MENA), and Asia. As related uptake activities depend significantly on Windows 1 and 2 funding to date, this intervention area has been reserved for the uplift budget, unless sufficient bilateral funding will crystallize.

2.3.1.3 Impact pathway and theory of change

In alignment with the overall WLE Theory of Change (ToC), the RUL Flagship will use four main impact pathways in its CoAs, of which the first three (*Fig. 2.3.2*) have been tested and successfully verified up to the outcome level in Phase 1 of WLE. For example, WLE is working closely with several key banks (Asian Development Bank [ADB], Water and Sanitation Program [WSP]/World Bank) where its research informs their investments. This was also confirmed by IEA (2016) which attested our significant progress towards outcomes. However, how far this will result in actual impact, and how we could improve our collaborations requires more research. As most of the research of the current RRR Flagship (on which RUL will build) was new, the whole impact pathway remains to be explored and the ToC must be closely monitored.

The impact pathways are as follows:

a. WLE's engagement with national authorities in the rural-urban interface, either directly or via our uptake partners, such as WSP of the World Bank, UN-Habitat and Centre for Science and Environment (India), and the collaboration of RUAF with ICLEI and UCLG. IEA (2016) considered the direct RUL predecessor (RRR) to be an especially highly focused flagship on piloting activities related to knowledge outputs with the government and the private sector.

b. WLE's collaboration with IFIs, which started under Phase 1 with WSP in different states of India and an advisory contract with ADB for Nepal; and a similar agreement to work with the African Development Bank (AfDB) for SSA, other donors for MENA, and RRR piloting supported by the Bill & Melinda Gates Foundation (BMGF).

WLE's support of the United Nations, in particular, UN-Water and United States EPA with research results and solutions for international public goods that include global safe reuse guidelines[34]. IWMI has an acknowledged track record in this regard, and is part of different United Nations-led expert groups and steering committees on water quality and wastewater use.

While we already work with the private sector to study the actual implementation of business models, a new pathway, with a ToC that still needs to be verified at all steps, is our engagement with renowned business schools in curriculum development, initiated in 2016. WLE signed a memorandum of understanding (MoU) with the Cambridge Judge Business School, UK, to translate our business model results and lessons learned into course material for an open-access curriculum. Other business schools are also interested, which would allow broader outreach and comparative analysis to identify options for improving the ToC.

[34] http://www.who.int/water_sanitation_health/wastewater/human_waste/en/;
http://www.who.int/water_sanitation_health/wastewater/usinghumanwaste/en/;
http://www.who.int/water_sanitation_health/wastewater/gsuww/en/;
http://nepis.epa.gov/Adobe/PDF/P100FS7K.pdf;
http://www.fao.org/docrep/016/i3041e/i3041e.pdf

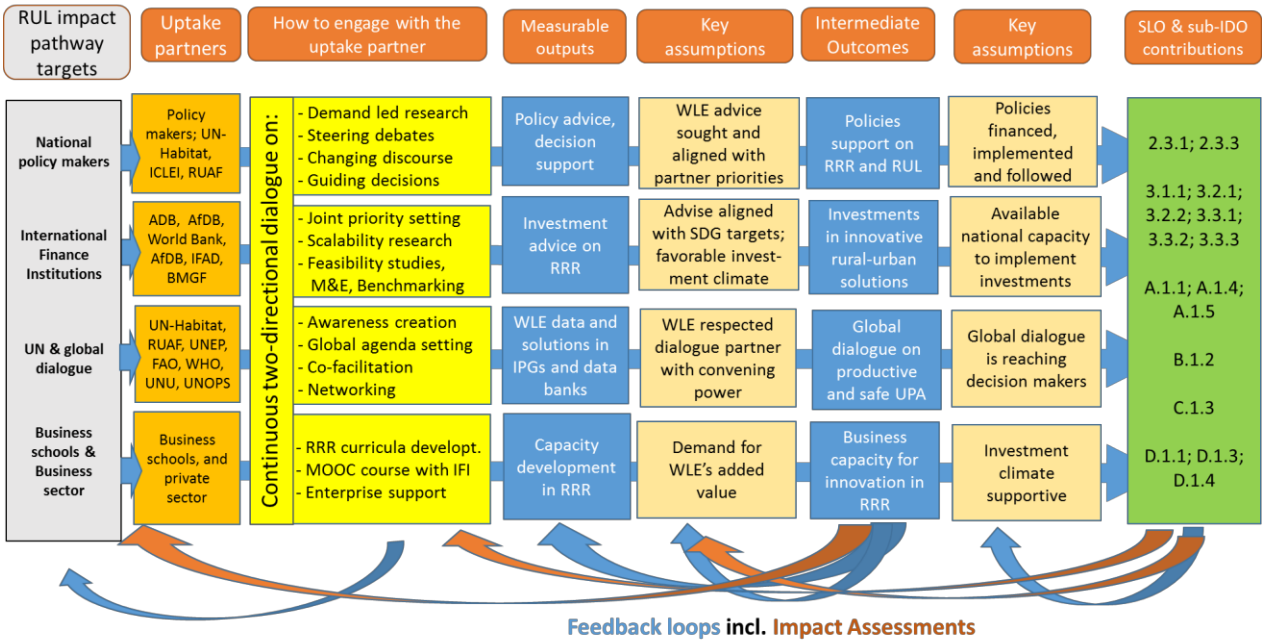


Fig 2.3.2: RUL Impact Pathways (adapted from WLE main text) ***(MOOC: Massive open online courses; RRR: resource recovery and reuse; RUL: Rural-urban linkages; UPA: Urban and peri-urban agriculture)***

To support an enabling environment for the uptake of WLE's research, close links to SDG-related investments (e.g. in food waste management and sanitation) will be important, along with the establishment of multi-sectoral platforms for policy and innovation dialogue (a strength of RUAF and UN-Habitat). This will enable the Flagship to mobilize, strengthen (capacity for research and innovation), inform and support stakeholders, and eventually enable them to take up the research.

2.3.1.4 Science quality

Following an invitation by BMGF, the RUL core team reviewed the state of research for linking agriculture and sanitation (rural and urban sectors) to assist BMGF in formulating its global strategy. This work took place in the same period WLE was designed, and led to the formulation of the research in the current RRR flagship, which started under WLE and will continue with a broader scope in the Phase 2. A key lesson from the original BMGF 'landscape analysis' was that, for many challenges, such as closed loop processes, we are not short of technical solutions. However, there are almost no viable models in developing countries; we find a few highly subsidized pilots which are neither sustainable nor reaching scale. This result helped to formulate our scientific entry point and value addition compared to other actors in the global research community. The science approach of the RRR/RUL Flagship builds on three pillars:

1) Interdisciplinary research combining engineering with institutional and environmental analysis, economics and business modeling.

2) R4D with outputs tailored to the 'next users' to facilitate uptake.

3) Close stakeholder interaction for feedback and buy-in.

For example, RUL's research under CoA 3.2 started in Phase 1 of WLE with the multi-disciplinary analysis of nearly 200 empirical RRR success stories, which allowed us to extract prominent business models for water, nutrient and energy recovery from agro-industrial and domestic food waste. The

analysis was carried out with business schools and team members from the private sector. The feasibility of these models was then tested in 10 new locations across the globe using a multi-criteria assessment framework (Otoo et al. 2016). As a direct follow-up, several of the most promising models were recently implemented at scale by WLE's development partners, such as Swiss Agency for Development and Cooperation (SDC), BMGF, Canada, Directorate-General for International Cooperation of the Government of the Netherlands (DGIS) and others, usually as public-private partnerships (PPP). This allowed us to further analyze the start-up phase, the robustness of the models, and local implementation challenges. These studies were accompanied by the analysis of the investment climate in various countries. The unconventional mix of staff and skills, which included PPP experts, entrepreneurs, and business modelers, drew the attention of the other WLE flagships and we intend to support their demand strongly under Phase 2.

The core scientists contributing to RUL are internationally recognized and cover a variety of disciplines. The Flagship was commended by the IEA for a balanced mix between senior, well-known researchers and more junior, highly-committed scientists. The designated Flagship leader, and leader of CoA 3.2, Pay Drechsel, has 25 years of R4D experience, with 15 years in CGIAR. Pay was also FP leader in Phase 1 of WLE, is very supportive of interdisciplinary studies, and will help to build on the success of the current RRR FP while further exploring, testing and verifying the theory of change. He will be assisted by Guy Henry from CIAT, who has a similar extensive track record and will take charge of CoA 3.1, while the designated head of CoA 3.3, Prof. Kala Vairavamoorthy, who joined IWMI in 2015, is an internationally renowned Integrated Water Resources Management (IWRM) expert who previously led the EUR 20 million European Union-funded global SWITCH project (www.switchurbanwater.eu). The research team is closely supported by Marielle Dubbeling, Director, RUAF Foundation, as co-Flagship leader for uptake, and FAO's 'Food for the Cities' Initiative, which will link WLE with municipalities and other uptake partners.

The IEA (2016) undertook a thorough evaluation of the Quality of Science of WLE, including the RUL predecessor RRR. The evaluation encompassed leadership and scientific staff, internal processes and enabling mechanisms pertinent to the conduct of high-quality research and science outputs. The IEA concluded that "the science within RRR represents an innovative and evidence-based approach to closing rural-urban nutrient loops and uses a novel adaptive, interdisciplinary approach across projects. Additional innovation was observed in demonstrating the business case for the technology, and in structuring multi-entity partnerships and consortia to leverage knowledge with convening power." This work, which was initiated under WLE Phase 1, will remain as CoA 3.2, the innovation **centerpiece** of the RUL Flagship.

Flagship publications reviewed by the IEA were ranked as 'good' to 'very good', which was attributed to rigorous adherence to IWMI's internal policies for publication quality review prior to submission to a journal. This will continue. A major book was among the IEA-reviewed publications which summarizes key results from Phase 1 of WLE (Drechsel et al. 2015); it was found to be an excellent compilation of knowledge and the book is expected to be highly useful to RRR stakeholders. IEA interviews with well-respected specialists in the interface of agriculture and sanitation recognize and laud RRR's scientific record and efforts at knowledge translation. We intend to continue this path of science excellence within the extended flagship scope, based on a thorough peer-review process and quality management guidance in partnership contracts.

Monitoring quality: Science quality is at the heart of CGIAR and will be monitored as far as possible via: 1) partner capacity and track record in research; 2) partner performance (citation index, etc.); 3) novelty of research; and 4) ability to learn and build on lessons from previous and ongoing work. Adherence to ethical research standards and output quality monitoring is, in the context of this

Flagship, an obligation of each participating research partner, based on their respective policies and management which will also be addressed in project contracts.

2.3.1.5 Lessons learned and unintended consequences

Significant achievements of the RRR Flagship in Phase 1 of WLE were: 1) analysis of a variety of business models for waste valorization and reuse; and 2) transformation of the flagship's Theory of Change into functional links with key uptake partners who appreciated the value we could offer. Success for the new RUL Flagship will depend on maintaining and building on these links with more emphasis on: 1) inclusive, multi-sectoral negotiation and decision-making platforms across the rural-urban divide, which are informing national investments and policy changes; 2) further engagement with international investors, development banks and the private sector to enable investments at different scales; and 3) strong support for capacity-development partners, which includes business schools and our United Nations partners for outreach and international public goods.

In its first phase, the RRR Flagship received very good feedback from the IEA as being innovative and outcome oriented. However, by entering uncharted terrain, significant lessons were also learned, for example, through our engagement with the **private sector**. Examples are the challenge of extracting business-relevant (financial) data, and the various administrative challenges the establishment of reuse businesses can face - even where the investment climate is considered favorable. In the PPPs we piloted in West Africa and Sri Lanka, the private sector often lacked the expected capacity. To support the postulated Theory of Change, we will have to translate the lessons into action and be either more selective in tendering and/or engaging more in capacity development, in partnership with already established players in this field. A typical bottleneck is that private companies within the sanitation sector still rely on the convenience of exclusive public finance for reducing waste challenges, without perceiving the need to engage in, for example, RRR and the exploration of reuse markets and other revenue streams. Institutional matchmaking and mechanisms for feeding revenues from agricultural reuse back into the sanitation chain is another example where we will have to do more research to improve our business model and better advise our uptake partners. Other lessons affecting our impact pathways, which are more commonly experienced in the CGIAR, concerned the transfer of partners, especially champions of change within national authorities, to other positions. As this situation can jeopardize, or at least delay, expected outcomes, risk management plans have to be extended as far as possible beyond the achievement of outputs to the achievement of outcomes.

Regarding potential **unintended consequences**, an increase in health risks could be the most significant challenge where waste-to-value business opportunities are taken up without integration of safety measures. To prevent such risks, RUL will ensure the availability of measures using, among others, the new WHO Sanitation Safety Plans (SSPs) as an operational guideline. The SSPs have been developed by WHO in a sister project to IWMI's RRR business model development. Risk assessment and risk mitigation are critical to RUL's research on waste as a resource, also considering that, in most low-income countries, the informal sector is an integral part of solid and liquid waste management (Hoornweg and Bhada-Tata 2012). A second unintended impact could relate to particular private sector representatives taking advantage of solutions we are developing or piloting. To avoid this situation, WLE is exploring licensing options where we maintain all solutions in the public domain as our intellectual property, and all supported PPPs are formed strictly according to local tender regulations. IWMI's private sector engagement policy will be used as a guide.

2.3.1.6 Clusters of Activity (CoA)

CoA 3.1: City-Region Food Systems and Urban Food Security

Geographical focus Lead: CIAT; Co-lead: FAO		
Countries	**Regions**	**Global**
Ghana, Burkina Faso, Ethiopia, Uganda, Kenya, Zambia, Senegal, Peru, Colombia, Vietnam, Sri Lanka, India	West and East Africa, Latin America, and South and Southeast Asia	Global dialogue

To address food security in an urbanizing landscape, the RUL Flagship has adopted the new concept of '**City-Region Food Systems (CRFS)'**[35]in CoA 3.1. CRFS offers an innovative entry point for addressing both food security from an *urban demand and consumption perspective*, and urban implications for the intensification of peri-urban and rural farming (Wiskerke 2015; Forster et al. 2015; Jennings et al. 2015; Grimm et al. 2008). Looking at the food chain, the urban (consumption) perspective complements the rural production-based value chain approach of the AFS CRPs. The consumption entry point is important as urban food security will be analyzed at the aggregate level at the urban end, with urban diets steering food production, livelihood impacts, and possible trade-offs in the rural-urban interface (DeClerck 2013).

The CRFS perspective enables a comparative analysis of the contributions of rural, peri-urban and urban farming to identify best ways to achieve sustainable intensification under space and water constraints, while preventing resource degradation. This includes possible positive or negative social and environmental trade-offs of agri-business, which have been flagged in the Independent Science and Partnership Council (ISPC) commentary on the **CGIAR Foresight Study** on 'Trends in Urbanization and Farm Size in Developing Countries', and can have a significant influence on rural youth in their search for greener pastures.

This CRFS perspective also allows the identification of vulnerable 'foodsheds,' which can be affected by economic shocks, political unrest or climate change, putting urban food security at risk (Newman et al. 2009), and the optimization of the use of water and land resources under multiple demands. The CoA will analyze different scenarios of urban growth and address the **SRF Grand Challenges**: 'competition for land and water' in peri-urban areas, and 'nutritious and diverse agri-food systems and diets'. The CoA research will also look at the farming system transformations described by Reardon et al. (2014) to provide a holistic landscape perspective on options for the optimal use of space and natural resources in the rural-urban continuum to support urban food security and short food chains with minimal social, health and environmental trade-offs. This will closely complement the focus of A4NH on diets and optimizing nutritional benefits.

Research questions:

The research questions to be addressed under this CoA are as follows:

1. How does urbanization affect rural-urban food and resource flows in view of water allocation, land availability (e.g. for agribusiness, aquaculture), soil productivity and ecosystem health in

[35] City-region food systems (CRFS) encompass the complex network of actors, processes and relationships to do with food production, processing, marketing, and consumption that exist in a given geographical region that includes a more or less concentrated urban center and its surrounding peri-urban and rural hinterland; a regional landscape across which flows of people, goods and ecosystem services are managed. http://cityregionfoodsystems.org.

rapidly changing rural and peri-urban landscapes? In particular, how are rural farming, youth and women being affected?

2. Which supply chains are the most vulnerable to shocks? How can more resilient city-region food systems enhance livelihoods, health, and opportunities for women and unemployed young people, and safeguard urban food security for the poor?
3. What are the complementary roles of urban, peri-urban and rural agriculture in feeding growing cities, and how could their roles be optimized under space and water constraints to support the sustainable intensification of city region agri-food systems?
4. What options exist to steer peri-urban agri-business development in such a way that it minimizes possible implications in terms of natural resources and ecosystem health degradations, and socioeconomic inequity?
5. What are the entry points for institutional change within the rural-urban continuum, and to what degree do these entry points vary across countries, cultures or by the size of the city?

Theory of change and Impact pathways:
Of the four impact pathways defined by RUL (see above), this CoA will mostly target two: 1) working across administrative boundaries, the CoA will support multi-stakeholder knowledge sharing, negotiation, policy formulation and decision-making platforms at city-region level to influence urban and national authorities; and 2) supported by its uptake partners, the RUAF Foundation, UN-Habitat and FAO, the CoA will feed its research results into regional and global dialogues (e.g. World Urban Forum). RUL uptake partners, such as RUAF, have significant experience in multi-stakeholder platform facilitation for policy change (Dubbeling and de Zeeuw 2007; Amerasingheet al. 2013) at different scales, from municipalities to the global network of UCLG, the global Cities Alliance partnership, or ICLEI-Local Governments for Sustainability. A particular uptake target will be the implementation of the Milan Urban Food Policy Pact, which was facilitated by RUAF and signed by over 100 cities.

Key outputs:
Research papers on CRFS effectiveness; vulnerability analysis and intensification options for urban and peri-urban farming systems; stakeholder platforms and training modules; city-region development scenarios and plans; urban food security strategies; urban food policies, gender-specific food waste management strategies; rural-urban trade-off analysis, and inclusive business models across the rural-urban continuum.

Outcomes:
Sustainable intensification with increased water- and nutrient-use efficiency supported on four Mha of urban and peri-urban irrigated and rainfed croplands, much of it cultivated by women. This will be based on increased capacity and evidence for stakeholders and policy makers to implement rural-urban innovations and related food policies, strongly supported by RUAF and FAO.

CoA 3.2: Business Options for Nutrient, Water and Energy Recovery and Reuse

Geographical focus Lead: IWMI		
Countries	**Regions**	**Global**
Sri Lanka, India, Ghana, Kenya, Nepal, Bangladesh	East and West Africa, South and Southeast Asia	Global dialogue

While cities are mining rural and peri-urban production areas, the food waste generated in cities is not returned and is resulting in growing waste and sanitation challenges. Resource recovery and reuse (RRR) is a fundamental pillar of sustainable NRM, and the **circular economy** principles cities and nations are increasingly adopting (Ellen MacArthur Foundation 2015). RRR is also part of SDGs 6.3 and 12.5 (increasing recycling and safe reuse). However, despite its theoretical potential, the linkages between the agriculture and urban waste sectors remain limited. Private sector engagement is especially low and solutions at scale are rare (Otoo and Drechsel 2016). CoA 3.2 will build on the previous RRR flagship, and work closely with the private sector and developed RRR business models to present bankable options for the safe recovery of water, nutrients and energy from domestic and agro-industrial waste using an inter-sectoral perspective with a stronger emphasis on institutional analysis and matchmaking. CoA 3.2 will also look at the financial and market opportunities that urbanization offers women and youth, in particular, young entrepreneurs, and, together with ICRAF, introduce viable models for the production of energy briquettes from different organic waste sources. Another component will analyze cultural, social and gender barriers and opportunities for behavioral change to mainstream safe RRR in agriculture and for energy recovery (Njenga et al. 2016).

The work will address two **SRF Grand Challenges**: soil degradation, and new entrepreneurial and job opportunities. The **innovation** in this CoA, as acknowledged by the external WLE evaluation, is in bringing business options and thinking into a sector that has so far been dominated by technical research on recycling options and reliance on public funding.

Research questions:
The research questions to be addressed under this CoA are as follows:

1. What are the local cultural, religious, social and gender barriers to mainstreaming safe resource recovery in agriculture and aquaculture? What are the opportunities and how can we change perceptions and behavior to support reuse while minimizing the associated environmental and health risks?

2. How can different waste streams be treated within the constraints of low-income countries for optimizing resource recovery for agriculture and energy recovery? How much private and public funding is needed to stimulate at scale enterprise development for a circular economy and how to make reuse a win-win across the sanitation service chain?

3. What incentive programs are helpful for reducing the sanitation sector's reliance on financial aid? What roles can businesses and Corporate Social Responsibility play in financing and managing a more resilient sanitation value chain and resource reuse?

4. How can we best design and position RRR curricula to increase the capacity of young entrepreneurs of both genders, partners and stakeholders in business thinking?

5. To what degree do the answers to these questions vary across countries, cultures and landscapes or by the type of waste stream and business involved? How can we guarantee that gender dimensions and equity are incorporated as a part of doing smart business?

Theory of change and impact pathways:
Based on the WLE and RUL theory of change, this CoA will build on different impact pathways to reach scale via: 1) capacity development through practitioner training and our business school partners, and 2) our partners among the IFIs/investment catalyzers (WSP, AfDB, ADB/Cities Development Initiative for Asia (CDIA), BMGF, International Fund for Agricultural Development (IFAD), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The uptake pathways with international development banks established under the current phase will be maintained and extended. The flagship will also continue

its engagement at national level with policymakers and the private sector to analyze the initiated PPPs and how our ToC can be improved.

Key outputs:
Scientific papers on RRR business models; RRR investment climate analyses; feasibility studies for women and youth, and trade-off analyses; investment plans and scenarios; PPP models for RRR; policy advice; RRR training modules and curricula (online).

Outcomes:
1) Increased business capacities in resource recovery from food waste supporting increased nutrient- and water-use efficiency on 3.6 Mha, returning through RRR up to 10% of initial NPK application, while preventing two million t CO_2e per year; 2) increased public investments and adoption of WLE policy advise on fecal sludge management for ecosystem service protection, targeting five IFIs and national policy change for the benefit of over nine million rural households and their management practices.

CoA 3.3: Integrated Urban-rural Water Management

Geographical focus	**Lead: IWMI**	
Countries	**Regions**	**Global**
India, Ghana, Egypt, Ethiopia, Syria	East, Northeast and West Africa, Southeast Asia, MENA	Global databases and guidelines

This third RUL CoA will continue WLE's work with WHO, FAO and UNEP on water quality risk assessments and risk mitigation where wastewater treatment has only low coverage. It will specifically support research related to monitoring the SDG 6.2.1 and 6.3.1 indicators, for which WLE helped to develop the methodology, and WLE's support of FAO's AQUASTAT wastewater database.

CoA 3.3 adopts a basin approach and builds on the concept of '**integrated urban water management'** (IUWM) (Bahri 2012), in support of governance solutions that minimize urban trade-offs on water quality and quantity, and related impacts on food security and food safety within the larger rural-urban landscape, as well as rural land-use impacts on urban water quality. Since agricultural intensification in close proximity to urban environments increasingly depends on irrigation, and water sources are commonly polluted, the impacts of poor sanitation on above- and below-ground water quality and food safety are important challenges in the rural-urban interface. These challenges often have significant implications for women and child nutrition (Spears 2013; Drechsel et al. 2013).

The research conducted under CoA 3.3 will address two **SRF Grand Challenges**: overdrawn and polluted water supplies, and food safety. It will support multi-stakeholder dialogues with development scenarios and related trade-off analysis for investments in rural and urban water needs. The innovation in this CoA is the application of an **integrated rural-urban stakeholder and research approach** for addressing water-related challenges in urbanizing landscapes.

Research questions:

The research questions to be addressed under this CoA are as follows:

1. How to promote institutional change and related planning capacity for joint rural and urban water governance to address interdependent development challenges in rapidly urbanizing watersheds and landscapes?

2. How can we increase the resilience of (peri)-urban ecosystems and communities, and better manage water competition, and the negative urban footprint on surface water and groundwater quality, ecosystem services, and public health in general?

3. How can we incentivize sanitation and extend safe wastewater use in low-income countries with limited treatment capacity to achieve the SDG reuse targets while protecting public health?

4. How far can urban services support, complement and co-exist with ecosystem services in order to maintain or increase the resilience of urban centers? What could be the role of urban payments for ecosystem services (PES) programs and how do these urban services best interact with rural services?

5. To what degree do the answers to these questions vary by the size of the city and pace of urbanization, and how can we support incorporation of gender, youth and poverty concerns into inter-sectoral governance models, trade-off analyses and conflict remediation?

Theory of change and impact pathways:
Based on the WLE and RUL theory of change, CoA 3.3's key impact pathway builds on our close and long-time collaboration with several United Nations partners to contribute to the global discourse around the monitoring of SDG indicators 6.2.1 and 6.3.1, assist in the development of safety standards for sanitation and water reuse, and other international public goods. As in CoA 3.1, a second impact pathway targets authorities via multi-sectoral stakeholder platforms, co-facilitated in this case by the Global Water Partnership (GWP) and UN-Habitat.

*Until **CoA 3.3** comes into full swing (in terms of separate reporting supported by sufficient W1/2 support under the uplift budget scenario and bilateral funding), individual projects will be mapped to the other two CoAs as well as to CoA 3.3. PIM contributions are for now subject to uplift funding.*

Key outputs:
Scientific papers on water allocation scenario modeling and supporting master plans, policy advice, risk analyses and risk mitigation options; databases on reuse and farmer field school training manuals (both with FAO).

Outcomes:
WLE referenced in **international public goods** developed with United Nations partners (contributions to FAO's AQUASTAT, water quality assessments and safe reuse guidelines, the World Water Development Report, etc.). Outreach target: 15 cities adopt the IUWM concept, and 500,000 irrigating women as well as male farmers in SSA, MENA and Asia understand safer wastewater irrigation practices with a return on investment (RoI) of USD 4.9 in consumer health benefits on every dollar invested in this CoA (Keraita et al. 2015).

2.3.1.7 Partnerships

The RUL Flagship will cut across commodity value chains related to urban food security as well as food waste; for this, we will collaborate as far as possible with AFS CRPs within the CGIAR country integration sites. A particular added value is the RUL expertise in business modeling and analysis for turning food and agro-industrial waste into an asset, and its related private sector focus. An example is the collaboration in West Africa, where the CGIAR Research Program on Roots, Tubers and Bananas (**RTB)** has significant technical expertise related to cassava waste, while the CGIAR Research Program

on **Livestock** and **Fish** are interested in turning waste into feed; **RUL** has expertise in viable business models for cassava waste and related economic feasibility studies.

Another example is the agreed collaboration with **A4NH** in the areas of water and livestock waste by specifically: 1) assessing risks and risk mitigation options for water- and food-borne diseases associated with vegetable farming in peri-urban key locations (under CoA 3.1); and 2) optimizing resource recovery (especially of energy) in livestock processing systems in East Africa for application in other locations (CoA 3.2). The RUL Flagship will also support A4NH to achieve impact via its partners WHO, FAO and UNEP in the domains of safe wastewater use and food safety. There are also important synergies being discussed between RUL and A4NH in CoA 3.1 to support city-region food systems. CIAT will facilitate RUL collaboration with the A4NH flagship on Food Systems.

Other inter-CRP collaborations are currently being discussed, e.g. with **Fish** on peri-urban aquaculture, water allocation and safety, and wastewater reuse; and with **Livestock** on slaughterhouse waste, water quality and fodder production with wastewater. The same applies to the rural-urban work of PIM where collaboration along the impact pathway offers win-win opportunities.

Outside the CGIAR, the key partners have already been mentioned per CoA in the impact pathway section. To support innovative business thinking for investment advice (CoA 3.2), we will maintain trustful relationships with IFIs (in particular, ADB, World Bank, AfDB, IFAD). For piloting solutions, we currently work most closely with FAO and RUAF in activities which fall under CoA 3.1, and with WSP, BMBF and CSE on public and private sector engagement (e.g. with Jekora Ventures Ltd., Pivot Ltd; Waste Enterprisers) under CoA 3.2. All these partners support research on innovative solutions and finance for going to scale, or rely on this, and thus have a significant comparative advantage for us, in view of RUL financing and our impact pathway.

Among CGIAR centers, IWMI and CIAT have a significant track record in research on rural-urban challenges and opportunities. However, to maintain a competitive edge and to support the anticipated outcomes, a number of current and new partners outside CGIAR are required, who understand urbanization-related implications for food security and NRM. This is reflected in the list of our partners along the impact pathway (*Table 2.3.2*). The co-leadership of the RUL Flagship by two uptake partners (UN-Habitat, RUAF Foundation) and, at CoA level, with FAO's Food for the Cities initiative and the Global Water Partnership (GWP), indicates the strong emphasis on achieving impacts and policy dialogue. While the RUAF Foundation has worked with WLE in the past, UN-Habitat is a new partner that is highly regarded within the urban development community. Both institutions can draw on their own networks e.g. via ICLEI for larger outreach.

Table 2.3.2 RUL Partners along the R4D Continuum

Partner type	WLE centers and CGIAR programs	Discovery/upstream	Proof of concept/pilot	Scaling out (downstream)
RUL Flagship	CIAT, IWMI, IFPRI, WorldFish, ICRAF, ICARDA, Bioversity; A4NH, FISH, Livestock, RTB, CCAFS	National agricultural research systems (NARS) and universities	Local government in project countries, IFI community (IFAD, ADB, AfDB, WSP/World Bank, GIZ)	UN-Habitat, RUAF Foundation, ICLEI - Local Governments (Alliance), FAO, GWP
		Universities in Holland, Ghana, Germany and UK;	National authorities and	Global Cities Alliance

Partner type	WLE centers and CGIAR programs	Discovery/upstream	Proof of concept/pilot	Scaling out (downstream)
CoA specific	CoA 3.1	NARS in Ghana, Burkina Faso, Ethiopia, Uganda, Kenya, Zambia, Senegal, Peru, Colombia, Vietnam, Sri Lanka, India; CIRAD	partners across the rural-urban divide	partnership for Sustainability, UCLG
	CoA 3.2	SANDEC/EAWAG; WRC (SA), CIRAD, SEI, different universities and NARS in Sri Lanka, India, Ghana, Kenya, Nepal, Bangladesh	Private sector and municipalities; IFAD, BMGF, Jekora Ltd., Pivot Ltd.; Waste Enterprisers	Business schools, WSP, AfDB, ADB, CSE (India), IWA, GIZ, SuSanA network, WBCSD
	CoA 3.3	UNESCO, SIWI, SEI, 2iE, WRC (SA), various universities and NARS in India, Ghana, Egypt, Ethiopia, Jordan, etc.	WHO, Municipalities, Water Aid	GWP, UNEP, CSE, WHO, IWA, UNU; World Bank

2.3.1.8 Climate change

RUL research strongly supports an enhanced capacity to adapt to climate risks, focusing on several entry points (Newman et al. 2009; Birkmann et al. 2010; Smith et al. 2014):

1. Reduced food waste landfilling and conventional energy use due to more reuse and recycling, and investing in a circular economy will potentially have significant effects on greenhouse gas emissions, given the continued urbanization trends, particularly in the global South. These effects will need to be explored to a greater extent, but most impact assessment models see great opportunities to reduce agriculture's climate impact by reducing food waste.
2. With the expansion of cities and their water and food needs, resource-use efficiency and water savings are now high on the policy agenda. With growing urban water demand and inter-sectoral water competition, water reuse is recognized as one of the priority adaptation strategies. RUL is actively supporting this need through its research on safe water reuse in farming, accounting for some 70% of the cross-sectoral water needs.
3. The rural-urban focus on supply chains (city-region foodsheds) analyzes urban food needs and supply under different rural and urban development scenarios, looking, in particular, at supply chains vulnerable to climate change and related events (droughts, floods) to find alternatives which increase the adaptive capacity of urban areas to enhance urban food security.
4. Access to affordable and clean energy is enshrined in SDG 13. To support the transition to more efficient and less land-degrading energy sources than wood-based fuel, particularly in sub-Saharan Africa, RUL will study opportunities for turning organic waste into alternative fuel sources.

2.3.1.9 Gender and youth

Rural-urban migration is an important entry point for research related to gender as well as youth.

With the feminization of many peri-urban areas due to the migration of men for urban work, RUL will work on social inequality and identify how women can be better supported (Tacoli 2012; Hovorka et al.2009; Fåhraeus 2014). Though RUL mainly looked at cultural roles, perceptions and benefits in Phase 1, which will continue, it has now prioritized gender-specific research in several areas. Examples are: 1) a comparative analysis of gender-specific income along traditional and exotic vegetable value chains in urban and peri-urban West Africa; 2) economic impact assessments of potential changes in fuel and cooking equipment, e.g. in East Africa and northern Ghana; and 3) analysis of opportunities for women in businesses based on nutrient recovery from domestic and food waste for agricultural reuse (analyzing how different business models will affect access to resources, and how access is shaped by customary norms, institutions, and political economy structures). This research and associated capacity development efforts will lead to modest but real outcomes before 2022, providing a foundation for achieving major improvements in women's health and well-being.

Rural youth migrating to urban centers has become a major challenge to agricultural production (Filmer and Fox 2014). RUL sees this as a main entry point for engagement in strengthening the acceptance and capacity of the informal urban sector to absorb young immigrants in urban and peri-urban farming, which can be highly profitable, especially for youth with farming skills. The objective is to make urban and peri-urban farmers accepted stakeholders of urban food supply by supporting their formal acceptance. This farming sector can be particularly attractive for youth, but remains as a "rural residue" in many cities, unsupported or even questioned due to the use of unsafe wastewater. This is a challenge for which WLE can provide a range of technical and policy solutions. For alternative strategies to keep youth in rural farming, the AFS CRPs are in a better position.

2.3.1.10 Capacity development

To support the enabling environment for innovation and uptake, in Phase 1, RUL began to analyze *gender-specific capacity constraints* along the impact pathway and to identify approaches to remove these bottlenecks. Based on lessons learned (see also Section 2.3.1.5), a key focus will be to support research and development partners in the analysis of business options (from supply chain analysis to market demand and investment climate), planning and investments across the rural-urban and sanitation-agricultural sectors. Similar support mechanisms will be developed to strengthen PPPs. A MoU has been signed with the Cambridge Judge Business School, UK, to support a free online curriculum on RRR business options for international students of both genders, and with national partners and development banks to offer adapted courses to municipal staff and entrepreneurs. To contribute to policy dialogue and institutional capacity development, our partner RUAF will support multi-stakeholder platforms building on several of the key elements outlined in the CGIAR Capacity Development Framework. The distribution and emphasis of the RUL CoAs in view of the CapDev elements is shown in *Table 2.3.3*.

Table 2.3.3. CapDev Elements Addressed by the RUL CoAs

CapDev Element	CoA 3.1	CoA 3.2	CoA 3.3
1. Needs assessments and intervention strategy			
2. Learning materials and approaches			
3. Developing CRPs' and centers' partnering capacity			
4. Develop future research leaders			
5. Gender-sensitive approaches			
6. Institutional strengthening			
7. Monitoring and evaluation			

CapDev Element	CoA 3.1	CoA 3.2	CoA 3.3
8. Organizational development			
9. Research on capacity development			
10. Capacity to innovate			
Key:	**High**	Medium	Low

2.3.1.11 Intellectual asset and data management

RUL is committed to the effective and efficient management of intellectual assets at every stage of the CRP life cycle, to effectively disseminate research outputs and maximize impact. RUL research outputs will be managed in line with the CGIAR Principles on the Management of Intellectual Assets and their Implementation Guidelines. RUL Intellectual Assets management treats research results and products developed under WLE as International Public Goods (IPGs) to maximize the impact of such products in a manner that fosters achievement of the CGIAR SLOs. A key dissemination pathway for maximizing global impact is the RUL publication of IPGs and databases with our United Nations partners UNEP, WHO, FAO, UNU and UN-Habitat. Further, all RUL partners, to the extent that they are able to align, will be supported to assume accountability for the appropriate implementation of the CGIAR Principles on the Management of Intellectual Assets and the CGIAR Open Access and Data Management Policy. The support will be based on three activities: 1) participation of all research partners in the project management life cycle; 2) targeting for wide dissemination of jointly agreed on data repositories and platforms, webpages and publications; 3) contractual commitment to open access; and 4) budget support for open access publishing factored into joint proposals.

There will be challenges in view of third-party property rights, which can be addressed through appropriate contractual agreements. Other challenges, as experienced in the current phase, are, for example, that the RRR private sector partners ask for non-disclosure agreements. Such situations have to be addressed case-by-case, but can be mutually solved through different ways of sampling and data presentation (see Section 2.3.1.5 on other challenges related to private sector engagement).

2.3.1.12 Flagship management

Flagship management will be subject to WLE's results-based management (RBM) strategy (see Annex 3.5), which outlines options for performance-based allocations and monitoring, non-financial incentives, reporting, evaluation, etc. The Flagship leaders are responsible for driving the flagship strategy and achieving its plans within the boundaries supported by W1/2 allocations. In the case of RUL, the leader will be appointed by IWMI, which has among the RUL partners the largest share of activities mapped to this Flagship. IWMI will be supported by RUAF as co-leader (supporting uptake), while UN-Habitat has agreed to function as global uptake advisor. Within the RUL CoAs, CIAT and FAO (CoA 3.1), and IWMI (CoA 3.2) share responsibilities for reporting, planning and representation for the two CoAs 3.1 and 3.2, which will go live under the base budget, including advice on outreach and uptake. Regular virtual meetings will keep the core partners aligned. The Flagship will be represented in the WLE MC through its designated leader.

2.3.2 Flagship Budget Narrative

2.3.2.1 General Information

CRP Name	Water, Land and Ecosystems
CRP Lead Center	IWMI
Flagship Name	Flagship 3: Sustaining Rural-Urban Linkages (RUL)
Center location of Flagship Leader	IWMI

2.3.2.2 Summary

Table 2.3.4 Flagship Budget Details

Total Flagship budget summary by sources of funding (USD)

Funding Needed	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	1,103,054	1,158,207	1,216,117	1,276,923	1,340,769	1,407,807	7,502,879
W3	0	0	0	0	0	0	0
Bilateral	5,200,000	5,460,000	5,733,000	6,306,300	6,936,930	7,630,623	37,266,853
Other Sources	0	0	0	0	0	0	0
	6,303,054	6,618,207	6,949,117	7,583,223	8,277,699	9,038,430	44,769,730

Funding Secured	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Assumed Secured)	1,103,054	1,158,207	1,216,117	1,276,923	1,340,769	1,407,807	7,502,879
W3	0	0	0	0	0	0	0
Bilateral	1,266,949	529,369	162,558	10,094	0	0	1,968,972
Other Sources	0	0	0	0	0	0	0
	2,370,003	1,687,576	1,378,675	1,287,017	1,340,769	1,407,807	9,471,847

Funding Gap	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Required from SO)	0	0	0	0	0	0	0
W3 (Required from FC Members)	0	0	0	0	0	0	0
Bilateral (Fundraising)	-3,933,051	-4,930,631	-5,570,441	-6,296,205	-6,936,930	-7,630,623	-35,297,881
Other Sources (Fundraising)	0	0	0	0	0	0	0
	-3,933,051	-4,930,631	-5,570,441	-6,296,205	-6,936,930	-7,630,623	-35,297,881

Total Flagship budget by Natural Classifications (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
Personnel	2,226,427	2,323,101	2,421,961	2,593,913	2,797,297	3,035,496	15,398,198
Travel	425,571	447,625	467,570	508,256	556,922	611,031	3,016,977
Capital Equipment	37,247	39,110	41,065	45,111	49,557	54,449	266,542
Other Supplies and Services	1,399,109	1,478,655	1,559,639	1,726,813	1,917,249	2,122,139	10,203,607
CGIAR collaborations	2,516	2,522	2,529	3,791	3,808	4,418	19,587
Non CGIAR Collaborations	1,424,137	1,499,731	1,587,506	1,757,348	1,918,056	2,081,049	10,267,829
Indirect Cost	788,044	827,459	868,844	947,988	1,034,807	1,129,845	5,596,989
	6,303,051	6,618,203	6,949,114	7,583,220	8,277,696	9,038,427	44,769,711

Total Flagship budget by participating partners (signed PPAs) (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
IWMI	4,345,520	4,562,796	4,790,936	5,229,773	5,710,481	6,237,145	30,876,653
CIAT	892,915	937,560	984,439	1,074,610	1,173,386	1,281,605	6,344,517
ICRAF	714,332	750,048	787,551	859,688	938,709	1,025,284	5,075,614
Tier 2 Partners	297,638	312,520	328,146	358,203	391,129	427,201	2,114,839
IWMI - WLE	52,648	55,280	58,044	60,946	63,994	67,193	358,107
	6,303,053	6,618,204	6,949,116	7,583,220	8,277,696	9,038,428	44,769,717

The total budget for RUL is about $45m over a period of six years, mainly funded from bilateral grants to the extent of 83% and the remaining 17% from W1/W2.

RUL will using an Activity Based Costing approach, trying to keep indirect cost and overheads as low and reasonable as possible within the concept of full cost recovery. Past efforts have shown a high return on investments (Keraita et al. 2015). The Flagship places high value on uptake and probably 40-50% of its budget will directly or indirectly support uptake activities, in particular through various CapDev elements. Gender activities will be supported in two ways: 1) through gender-specific research (10% of the budget) and 2) gender-sensitive research (mainstreamed via partner centers). The overall budget share in support of youth is expected to be around 20% (with a partial overlap with the Capacity Development budget).

Like WLE as a whole, RUL depends largely on bilateral funding, generated by all partners. The major risk to the expenditure plans outlined is the limited knowledge available at this early stage of the funding landscape over the course of the next six years. The W1/W2 and bilateral funding summary in the table below is based on the best (past records, future pipeline) estimates available. Given the dynamic experienced over the last two years, funding availability will almost certainly fluctuate compared to what is provided here, which will affect the activities that the Flagship is able to complete, expected outcomes, and the corresponding classification of costs. The W1/2 allocations will be essential to coordinate the flagship efforts and to set priorities as far as possible. Another spending risk is the contractual pre-allocation of W1/2 funds to partners without security if bilateral funds will crystallize and of what our partners will qualitatively and quantitatively deliver. WLE has put in place a results based management system which will include performance-based funding allocations. The breakdown of costs by targets, sub-IDOs and outcomes is stated in the PIM tables and budget.

The components of benefits are, home leave, pension, vehicles, housing, educational allowance, and health insurance. Each center working as part of this program has clear policies and procedures with regards to each of the above cost components which may differ from center to center and category

of employment (national, regional, international, etc.). The policies vary among partner centers and are based on local laws and needs.

2.3.2.3 Additional explanations for certain accounting categories

Supplies and services are budgeted as per the costing principles laid out in Financial Guidelines 5 issued by the Consortium Office.

The cost can be broadly categorized into two categories:

1. Research Support and Quality and Coordination costs: Services or research support costs for a CGIAR Center include research oversight, facilities (or occupancy costs) and general services like rent, utilities, IT, phone/fax etc. Other costs include project oversight, data management and depository, and output quality control which are not fully charged on common budget lines.
2. The calculation of charge out rates is based on CGIAR Financial Guideline Series No 5 whereby costs that are not directly research related are treated as research support. The cost of the services is allocated to benefiting projects based on utilization of these services by research staff. Utilization is measured by the number of direct labor hours incurred by research staff while providing direct research support under each project.

The direct costs include consulting services, professional services, publications or subscriptions, conferences/ workshops, communications, postage and other miscellaneous costs which are essential for providing the resources to conduct the planned activities and achieve the targeted outcomes. The estimation of the costs has been determined using phase 1 costs as a baseline.

2.3.2.4 Other sources of funding for this project

If funding does not crystallize as expected, the CRP and its flagships will have the same limited options to deliver as planned as all other flagships and CRPs. These options include that we discuss with our contracted centers in charge of the potentially jeopardized outputs and outcomes, options for optimizing W1/2 fund allocations by scaling down projects with less impact on set targets if this is supported by the contractual arrangement. Solutions have then to be affected by the Centers and can be supported by the Flagship. This support could include targeted fund-raising campaigns, and a cross-center dialogue on options for shared staff task relocations.

2.3.2.5 Budgeted costs for certain key activities

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
Gender	840,000	All CoAs of the RUL flagship will allocate on average about 10% of their budget to gender-specific research, while a much larger percentage goes naturally into gender sensitive research. The flagship will research gender and social inequality by addressing the different cultural roles, perceptions and benefits related to food waste and alternative energy sources, in order to support women to have more opportunities and develop their capabilities to assume more prominent roles. Examples of gender-specific research are: 1) the planned comparative analysis of gender specific income along traditional and exotic vegetable value chains in urban and peri-urban West Africa; 2) the adoption potential and economic impact assessment of changes in fuel (towards waste-based alternatives) and cooking equipment in East Africa and Northern Ghana; and 3) the cross-regional analysis of opportunities for women in businesses based on nutrient recovery from domestic and food waste for agricultural reuse.
Youth (only for those who have relevant set of activities in this area)	420,000	RUL will study in CoA 3.1 options to support youth employment in urban agriculture. Many youths with agricultural background who are migrating to urban centers first find employment in open-space market-oriented urban and peri-urban agriculture, which offers attractive income generating opportunities. CoA 3.1 will support an analysis of such business opportunities and strengthen the related policy support for urban farming. RUL will also support under CoA 3.2 the development of fact-based curricula and learning materials for youth to engage in resource recovery businesses such as waste recycling for fertilizer production or energy generation. The overall budget share in support of youth is expected to be around 20% (with a partial overlap with the Capacity Development budget).
Capacity development	994,000	RUL CoA 3.2 has a significant share of activities devoted to the development of curricula for business students, practitioners and future leaders to be used in different schools and ways, including a MOOC. This work will be done with strategic CapDev partners and require staff time, innovative learning materials and operations and take up to 30% of the budget. Another major activity under CoA 3.2 is institutional strengthening towards evidence-based decision making and

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		investment advice. Also this will require staff time, material and communication costs and consume another 20% of the CoA 2 budget, including strategic W1/2 allocations. CoAs 3.1 and 3.3 will support multi-stakeholder learning platforms for city-region dialogues at local and internal scale which will be facilitated by RUAF and local partners and consume approximately 30% of the CoA budgets. Overall, we are expecting that about 40-50% of the overall Flagship budget will directly or indirectly support the impact pathway, largely through the various CapDev elements, in particular institutional strengthening.
Impact assessment	126,000	*Ex-post* impact assessments will be built into project activities as appropriate and in line with WLE's overall evaluation and impact assessment strategy. In addition, RUL will perform *ex-ante* risk assessments as a baseline for the analysis of health risk mitigation measures in CoA 3.3, where wastewater irrigation is common. For RRR business models, the economic impacts are also regularly assessed via economic analysis. *Ex-post* impact assessments will be built into project activities where implementation of our research will take place during the WLE Phase 2 lifetime. For our work in WLE Phase 1, we are planning an impact assessment of our influence of global wastewater use guidelines. The budget for impact assessment is part of a broader budget for Monitoring, Evaluation, Impact Assessment and Learning (MEL), for which approximately 10% of the time of each Flagship Leader and 5% of Project Leaders will be allocated, which will include reporting and oversight, with additional funds incorporated into the lines on travel, supplies and services.
Intellectual asset management	162,400	Compliance with the CGIAR Principles on the Management of Intellectual Assets is task of each WLE partner center and backstopped by the Lead Center Legal officer and Business Development Director, covered by supplies and services budget. This process will be supported by the CRP management at CRP level.
Open access and data management	70,000	Compliance with the CGIAR Open Access and Data Management Policy is task of each WLE partner Center, and not funded by individual flagships. However, the flagship will encourage researchers to budget in proposal resources to cover OA/OD, like open access fees for articles; database membership fees; server and hardware costs. Staffing costs will be covered by a combination of personnel costs and

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		supplies and services. Operational costs are limited in RUL to CoA 3.2 where we support UN databases and publications to achieve a high level of OA/OD.
Communication	540,000	The resources required for Knowledge Management and Communication (KMC) are budgeted in each RUL project, funded by W1/2 or bilateral. RUL plans under its CoAs, communication via different media (press, radio, TV, blogs, etc.), online training courses, using such knowledge products as training manuals, business models, investment and policy briefs, decision support systems, and academic books and papers. Activities will also include engaging with stakeholders, including participating in policy level discussions and fora, engaging in key events at the national, regional and global levels, and in particular in multi-stakeholder platforms across the rural-urban sectors. The activities will involve WLE uptake/ communication staff based in participating Centers. The Flagship will also work closely with program level KMC on strategic communications planning and implementation.

2.3.2.6 Other

The indirect costs in this budget include costs for support service units like HR, Finance, and Administration etc. In case there is a sudden decrease of funding. Indirect costs will remain at a higher rate as it will take time to make adjustments. The Indirect cost rate is based on Financial Guideline 5 of CGIAR cost allocation guidelines.

The highest risks with regards to this Flagship are instability of funding and increase of costs due to change in external and internal environment. The Program team under the leadership of the Lead Center will review the risks on a quarterly basis and ensure that budgetary adjustments are tracked due to these risks.

The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the bilateral projects mentioned in this budget will be approved without any variance. Partnerships, one of the most important components in the proposal, are mainly budgeted under bilateral projects and are a measure to minimize risk arising from the fluctuations in windows funding.

Inflation is considered in the costs at 2.63% which is based on the average IMF projections for the next 6 years. The major costs are incurred in USD and therefore the risk in foreign currency exposure is insignificant.

2.3.3 Flagship Uplift Budget

Outcome Description	Amount Needed	W1 + W2 (%)	W3 (%)	Bilateral (%)	Other (%)
Outcome 3.4 Improved institutional capacity within 15 cities leads to the adoption of IUWM principles and actions to harmonize rural and urban water demands	5,377,300	50	0	50	0
Outcome 3.5 Improved institutional capacity for safe agricultural water use reaching 0.5m wastewater using farm households	8,603,600	50	0	50	0
Outcome 3.6 Awareness created on organic soil rehabilitation options via RRR leading to action for 1m ha of tea, palm and tree plantation soils in South Asia and East Africa	5,874,800	50	0	50	0

2.4 WLE Flagship Project 4: Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)[36]

Lead centers: IWMI & IFPRI
Partner centers: WorldFish, CIFOR, IUCN

2.4.1 Flagship Narrative

2.4.1.1 Rationale and scope

According to the Emergency Events Database (CRED 2014)[37] and the CGIAR Strategy and Results Framework (SRF) (CGIAR 2015), about 150 million people are affected and some 25,000 people die from water-related disasters annually worldwide, with an economic loss of USD 165 billion across all economic sectors. This is projected to increase to USD 200-400 billion by 2030, according to various estimates. These losses strongly affect food security and exceed current total development aid flows.

Agriculture is at the heart of this water variability; it is the sector most affected by droughts, absorbing, on average, 84% of adverse economic impacts, and 25% of all damages from climate-related disasters (FAO 2015). Not only scientists and farmers, but even the business community considers variability, casted as "extreme weather events", as one of the most likely production risks over the next 10 years (World Economic Forum [WEF] 2015). Phase 1 of WLE assessed the welfare gains from mitigating hydrological variability at large by securing water to existing irrigators, globally, at USD 94 billion for 2010 alone (Sadoff et al. 2015). At the same time, water variability provides significant benefits, for example, for capture fisheries and flood-recession agriculture. Hence, managing variability is not about eliminating it, but rather minimizing damages and maximizing the opportunities it provides.

Both recent trends of growing surface storage development and aging water infrastructure, point to a need for innovative solutions that embed ecosystem service (ESS) perspectives, resilience, and livelihood considerations more prominently in planning and management that explicitly addresses variability. These trends, exacerbated by rapid population growth, urbanization and other increasing pressures on water resources, also call for assessing costs of trade-offs between competing uses and benefits from synergistic management across the water-energy-food nexus (Ringler et al. 2013).

Modeling scenarios developed during Phase 1 of WLE have shown that the water security of 36% of the global population, as well as 40% of grain production and 25% of global gross domestic product (GDP) are at risk due to unsustainable water use. Under a business-as-usual scenario, by 2050, these numbers will rise to 52%, 49% and 45%, respectively, with withdrawal levels above 40% of renewable water resources (Ringler et al. 2016a). Other findings from Phase 1 identified rapidly growing risks from water pollution in the developing world (IFPRI and Veolia, 2015), and a greater reliance on, and declining sustainability of, groundwater use in parts of Asia and Africa (Altchenko and Villholth 2015). Beyond gendered impacts due to variability, Phase 1 showed that men and women deal with natural resource management (NRM) and variability differently depending on their responsibilities and their socially prescribed roles (Baker et al. 2015; Meinzen-Dick et al. 2014).

[36] All acronyms are defined when first used and then summarized in Annex 3.14.
[37] All references are listed in Annex 3.15.

Agriculture consumes 30% of global primary energy resources. Therefore, solutions that increase resource-use efficiency across the water, energy and food sectors are imperative (Rosegrant et al. 2013) and can enhance climate and food security outcomes (Ringler et al. 2016b). Another visible recent trend is the accelerated development of clean energy sources that are projected to constitute up to 20% of the global energy balance by 2050. This trend results in significant challenges and opportunities for water and agriculture in "solar belt" regions (most of the "South"), which are yet to be fully explored (Sood and Smakhtin 2014).

VCR will primarily contribute to the following three Grand Challenges out of the eight targeted by the SRF:

- *Competition for land and water from multiple sources:* The core work of VCR will explore how trade-offs across the water, energy and food sectors, from local to transboundary scales, can be reduced, and identify opportunities for increased resource-use efficiency for agri-food system (AFS) CRPs.
- *Overdrawn and polluted water supplies:* VCR will address the challenges of growing water scarcity and degradation (both exacerbated by variability) by identifying policies and investments that redress root causes, e.g. lack of investment and poor management of 'grey' and 'green' infrastructure, including underground storage, and coordinating solutions to water degradation and pollution across WLE.
- *Climate change threatening agriculture:* The major global manifestations of climate change are increasing climate and water variability, which affects the availability of water and other natural resources. VCR aims to reduce the negative impacts of variability on agriculture in the context of competing uses.

VCR will also contribute to the resolution of the Grand Challenge of *Unsustainable harvests of fish and other aquatic products* by exploring solutions along the hydropower-fish nexus in river basins together with the FISH Flagship Project 2 (FP 2).

VCR complements other WLE flagships, and the CGIAR Consortium work at large, by explicitly focusing on reducing risks and losses to agriculture from *water-related* disasters (primarily floods and droughts) and natural resource trade-offs (in the context of irrigation-hydropower and broader water-energy and other nexuses). Large-scale landscape-based solutions to manage variability and resource trade-offs will directly support the work of the ESA Flagship - integrated regional strategies to enhance sustainable agricultural intensification. Large-scale agricultural pollution analyses under the uplift scenario will complement targeted water, land and intensification activities in LWS, RDL, RUL and ESA Flagships. VCR together with GID will enhance the capabilities of women and their access to knowledge, credit, and labor to improve their resilience and ability to deal with variability. As shown further in Sections 2.4.1.6 to 2.4.1.8, and detailed in Annex 3.6, VCR has profound established links with the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS), and will have strong contributions and synergies across several AFS CRPs, including FISH, WHEAT, MAIZE and RICE.

2.4.1.2 Objectives and targets

The Flagship aims **to enhance the capacities of men, women, communities, governments and the private sector to reduce the risks associated with rapidly increasing variability, scarcity and degradation of natural resources, water-related disasters and competing uses of water, land and energy, and to facilitate the availability of these resources to all.** VCR will assist decision makers to

sustainably and equitably manage risks and trade-offs by: 1) reducing human and economic losses to agriculture due to floods, droughts and the degradation of ESS affecting agriculture, by developing innovative ESS-based solutions at the landscape, basin, regional and global scales; and 2) co-developing innovative policy mechanisms and institutional arrangements to reduce the mounting pressures on agricultural systems from competition for land, water and energy through case-specific solutions, and upscaling these solutions to regional and global levels. Accordingly, VCR organizes its work in two cohesive Clusters of Activities (CoA): 4.1: *Managing resource variability and risks for resilience*, and 4.2: *Managing competing uses and trade-offs.*

Through the provision of data, information and expertise, VCR will support the implementation of SDGs 1, 2, 6, 11, and 13, and in particular SDG target 6.4: substantially increase water-use efficiency across all sectors and ensure sustainable withdrawals and supply of freshwater to address water scarcity and substantially reduce the number of people suffering from water scarcity. VCR is also positioning itself to directly contribute to the global targets for disaster risk reduction set by the 2015 Sendai (Japan) Summit that aims to reduce, by 2030, mortality, number of affected people, crops and infrastructure losses.

The Flagship will address System-level Outcome (SLO) 3 on improved natural resource systems and ESS through the three Intermediate Development Outcomes (IDOs): 1) enhanced benefits from ecosystem goods and services; 2) more sustainably managed agro-ecosystems; and 3) natural capital enhanced and protected, especially from climate change. VCR contributes to SLO 1 (reduced poverty) through the IDOs on: 1) increased resilience of the poor to climate change and other shocks; and 2) reduced production risks. It also addresses the crosscutting sub-IDOs on enhanced capacity to deal with climatic risks and extremes, and an enabled environment for climate resilience through its close links with CCAFS and several AFS CRPs. *Table 2.4.1* presents some estimates of contributions of the proposed research to the CGIAR sub-IDOs and the SDG targets.

Table 2.4.1 VCR Outcomes, Related IDOs and SDGs, and Projected Budgets (6-year base budget)

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	2022 Targets	Budget (USD '000 & %)
4.1	SLO 3; sub-IDO 3.3.2: **Enhanced adaptive capacity to climate risks** (SDG 1.5, 2.4, and 13.1) SLO 3; sub-IDO 1.1.2: **Reduced production risks** (SDG 11.5 and 13.1) SLO 3; sub-IDO 3.3.1: **Increased resilience of agro-ecosystems and communities, especially those**	India, Nepal Bangladesh	**A.** Increased evidence base for stakeholders and policymakers to implement WLE solutions that increase **water supply** for agricultural production, livelihoods and ecosystems, and decrease economic and human **losses** from water variability extremes	Investments to reduce hydrological variability impacts by 5% adopted in selected irrigation systems in South and Southeast Asia; Investment, policy and institutional changes contribute to up to USD 20 million in avoided damages each year by 2022 in the Ganges Basin alone	19,643 (30%)

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	2022 Targets	Budget (USD '000 & %)
	including smallholders (SDG 2.4)				
4.1	SLO 3; sub-IDO 3.3.1: **Increased resilience of agro-ecosystems and communities, especially those including smallholders** (SDG 2.4)	Lao PDR, Cambodia, Ghana, Kenya	**B.** Increased public and private sector adoption of WLE policy advise on changes in water resource **infrastructure** planning and management, leading to enhanced ecosystem services and increased resilience	Landscape-based variability management approaches adopted by a minimum of 6 million households in India and Bangladesh, poverty alleviation for up to 3 million people in the same countries; additional but smaller outcomes in sub-Saharan Africa (SSA)	13,095 (20%)
4.1, 4.2	SLO 3; sub-IDO 3.2.1: **More productive and equitable management of natural resources** (SDG6.4)	Ghana, Ethiopia, Southern African Development Community (SADC) region; India, Bangladesh, Cambodia, Pakistan	**C.** Increased public investments into, and adoption of, WLE policy advise on measures to reduce **groundwater** depletion and promote its sustainable use with associated increase in agricultural incomes	At least 1% of the SSA groundwater irrigation potential area realized; water-use efficiency in SSA increased by at least 5% over current rainfed water management with low yield levels	19,643 (30%)
4.2	SLO 1; sub-IDO 1.1.2: **Reduced production risk** (SDG 11.5 and 13.1) SLO 3; sub-IDO 3.1.1: **Land, water and forest degradation minimized and reversed** (SDG 6.4 and 6.6)	Countries of the Nile, Mekong and Volta river basins	**D.** Alignment of regional **energy plans** and food security initiatives with available water resources, leading to reduced production risks and increased resource-use efficiency	10% of water-energy-food nexus savings valued at USD 2 billion targeted in Ganges, Nile, Volta and Mekong river basins (leveraging billions of USD in planned infrastructure investments in these regions)	13,095 (20%)
4.1, 4.2	SLO 3; sub-IDO 3.1.1: **Land and water degradation minimized and reversed** (SDG 6.4 and 6.6)	Countries of the Nile, Volta, Ganges and Indus river basins	**E.** Farmers in Asia adopt WLE technologies that reduce **water pollution;** Outcome **A** is extended to cover Sri Lanka, Thailand, Myanmar, Vietnam and China. Outcome **B** extended to cover Ethiopia, Nigeria, Zambia and Vietnam;	Agricultural water pollution levels (nitrogen [N], phosphorus [P], sediments and salinity) reduced by 5% over baseline increase in Asian breadbasket region	Uplift budget (not part of the base total below)

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	2022 Targets	Budget (USD '000 & %)
			Outcome **C** extended to cover five more countries in SSA; Concepts and tools for operationalization of 'water security' and 'sharing adaptation in transboundary settings' are adopted in four large river basins in Africa and Asia		
				Total base budget (W1,2,3, bilateral)	**65,477**

2.4.1.3 Impact pathway and theory of change

VCR aims to achieve the outcomes and SLO contributions listed in *Table 2.4.1* and *Figure 2.4.1* through collaborating with five categories of uptake partners: 1) national- and basin-level policymakers; 2) investors, including the private sector and multilateral development banks; 3) global development dialogues, including on climate change and the SDGs; 4) National Agricultural Research and Extension Systems (NARES) and practitioners; and 5) AFS CRPs co-investing in joint sites and/or using VCR tools as inputs. VCR research will go beyond the main focus of Phase 1 that identified key challenges for sustainable intensification in a more variable and natural resource-scarce world to piloting selected interventions and identifying scalable ones; assessing gender equity and feedback on interlinked resources and impacts; developing priority databases and decision-support systems; and building capacity in these areas.

The goals of VCR are ambitious. It seeks to influence numerous policies across a large number of countries. To be effective, the Flagship will work with partners who are familiar with the policy set-up and have a good understanding of the contexts within which decisions are made in each of the countries where it works. However, achieving change is never straightforward and we recognize the need to adapt and modify approaches both as things change, and as our understanding of the complexities inherent in systems grows, over time. Hence the feedback loops in the impact pathways (*Figure 2.4.1*) reflect the need for adaption: modifying approaches to best target, at any given time, the institutions and stakeholders (including brokers of information and networks of influence) that are key to more effective application of evidence and influence of change.

To achieve outcomes and impact, a series of assumptions needs to be met, such as funding availability for cross-AFS CRP engagement; VCR advice sought and aligned with national, basin and regional priorities; and a supportive enabling environment that recognizes the fundamental interdependencies between agro-ecosystems and the natural resource base (*Figure 2.4.1*). Given the large scale of some of the VCR proposed assessments and management options, we will use scenario analysis (continuing work initiated with PIM during Phase 1), tradeoff dialogues and scaling analyses both when developing pilots and when expanding from pilots into larger areas, such as on managed aquifer recharge in the Ganges region; and we will assess local cultural, religious, social and gender barriers that need to be overcome to accelerate the adoption of this and other ecosystem service-based solutions.

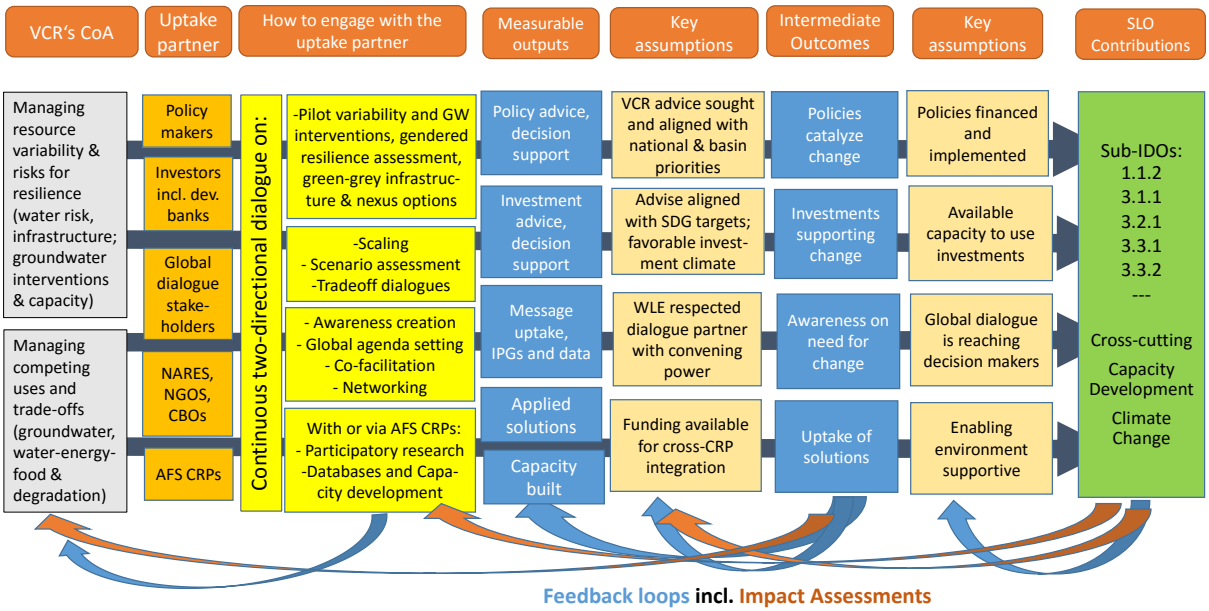


Figure 2.4.1 VCR Impact Pathways

VCR will focus on those breadbasket areas that are most affected by variability and competing uses, and thus are likely to be most receptive to this work. Demonstrated evidence of the demand for VCR work includes: 1) requests from the disaster and agriculture ministries in Sri Lanka, India and Nigeria, as well as from global re-insurance companies, requesting VCR flood inundation products for relief measures or damage assessment; and 2) multilateral banks requesting VCR assistance in formulating frameworks for groundwater management in South Asia, and in assessing the impact of agricultural water on economic growth (World Bank [WB]), support for overall regional agricultural strategy development in Central Asia (Islamic Development Bank [IDB]), and support for a water-energy-food nexus checklist for Asian irrigation (Asian Development Bank [ADB]). The intention is to build on these examples of high-level interest in VCR research, and to determine locally appropriate mechanisms for uptake, in coordination with the ESA Flagship. We will use targeted outreach materials to reach audiences successfully, differentiating between policy- and technically-oriented stakeholders. This may include, amongst others, videos that illustrate achieved or possible impacts, as well as engagement in major fora and dialogues.

Given the multiple sectors and global reach of water variability effects, CoA 4.1 on *Managing resource variability and risks for resilience* will collaborate with all five categories of uptake partners. These include governments, particularly disaster management agencies, multilaterals and the International Fund for Agricultural Development (IFAD); humanitarian organizations, such as World Food Program (WFP), Red Cross and United Nations Children's Fund (UNICEF); private sector entities concerned with managing production and reputational risks (e.g. hydropower companies, food and beverage producers); and the Global Disaster Risk Community of Practitioners. In Phase 2, research will be developed with AFS CRPs operating in large deltaic systems (e.g. FISH), and co-investment with CCAFS will be expanded to cover groundwater solutions to floods as well as pro-poor farmers' flood insurance. We will pilot VCR solutions with central and local governments, farmer associations, relevant United Nations University (UNU) institutes, World Meteorological Organization (WMO), and the Global Water Partnership (GWP). At global level, we will continue to try to influence effective monitoring of SDG indicators and Sendai Framework for Disaster Risk Reduction 2015-2030 targets through the United

Nations International Strategy for Disaster Risk Reduction (UNISDR). CoA 4.1 will also continue to engage with global advocacy and practitioners' networks and dissemination avenues, e.g. United Nations Office for Outer Space Affairs (UNOOSA), Group on Earth Observations (GEO) and Sentinel Asia. The main strategy is to work directly with most of the next users of VCR outputs, engaging major international networks and processes to generate large-scale awareness, additional demand and uptake.

CoA 4.2 on *Managing competing uses and trade-offs* will work with national and basin agencies in the water, energy and agriculture sectors on effectively addressing competing water uses and nexus challenges. To help ensure impact and uptake at larger scale, CoA 4.2 has established close working relationships with several environmentally-focused development partners that increasingly see agriculture as part of the solution to growing resource scarcity and degradation. These include IUCN, United Nations Environment Programme (UNEP), World Wide Fund for Nature (WWF) and the Ramsar Convention. To broaden WLE's reach on the water-energy-food nexus, new alliances have been developed with FE2W, the Earth Security Index, International Institute for Applied Systems Analysis (IIASA), International Council for Science (ICSU) and the Future Earth Sustainable Water Future Program. CoA 4.2 will also continue collaborating with multilateral banks and donors, including science and private foundations, and change agents such as the German and Indian governments, for uptake and outreach of key findings. This cluster will also interact directly with the private sector, including individual hydropower and global water supply companies (e.g. Veolia), to enhance ecosystem services through dam re-operation and enhanced management. It is recognized that many water resource decisions at national and sub-national level, especially those where trade-offs exist, are beset by vested interests. VCR approaches, however, should be able to alleviate such constraints by targeting higher level considerations, such as reputational and production risks, and longer-term sustainability. In Phase 2, VCR will build on these relationships and develop new links, particularly with AFS CRPs, to assess and test agricultural and non-agricultural solutions to growing trade-offs across competing uses of resources for joint analyses and more holistic impacts and outcomes. To support decision processes, VCR will work closely with ESA CoA 5.2.

2.4.1.4 Science quality

The VCR predecessor – MRV FP in Phase 1 of WLE – has effectively put forward an overarching new concept for NRM through the prism of resource "variability" as opposed to conventional "scarcity" (WLE 2012). Phase 1 made significant progress towards the development of variability concepts and solutions in the context of competing uses, including underground water storage solutions, green and grey infrastructure, the explicit introduction of livelihood aspects into water storage management, use of experimental games to strengthen collective action institutions around water storage, exploration of insurance options against disasters, and further development of the storage continuum, among others. As mentioned earlier, these concepts will be moving higher along the Impact Pathway in VCR - to piloting and upscaling. In addition, new research initiatives will be developed and rolled out under VCR in Phase 2, chief among them the **Groundwater Solutions Initiative for Policy and Practice (GRIPP)** (see more in Section 2.4.1.6), a renewed focus on unpacking water security and economic growth, and other elements. VCR science will, therefore, guide the prioritization of interventions and investments that alleviate negative aspects of variability and trade-offs.

The VCR research core team includes 10 researchers primarily from IWMI, IFPRI and WorldFish. All the researchers have an h-index greater than 12, and half of the team have an h-index higher than 21, indicating the team's capacity to assure the scientific quality and strategic research direction of VCR. IEA (2016) noted that "*indices between 10 and 20 in scientific areas such as those covered by WLE*

would be widely accepted benchmarks for tenure and promotion to full professor in academia and an h-index greater than 20 is often acknowledged to be indicative of significant scientific contributions to a particular field". The contributing core scientists (see Annex 3.7) are internationally recognized experts in their research fields and have proven track records in the VCR research for development (R4D) agenda.

Science quality will be monitored via partner records of research performance (citation index, etc.), and partner regional/global recognition. Each participating research partner has its own peer-review processes, based on its respective quality control mechanisms which will be addressed in project contracts. The quality of science of this flagship has been evaluated by the CGIAR IEA in 2015/2016 (IEA 2016). The evaluation encompassed VCR staffing (leadership and scientific staff), internal processes, and enabling mechanisms that ensure high-quality research and science outputs, primarily captured in peer-review sources, but inclusive of non-peer reviewed outputs that are particularly important to communicating science results to stakeholders. The IEA evaluation also considered previous analyses of WLE science, including 1) the IWMI-Center Commissioned External Review (CCER) of Science Quality and Relevance; and 2) the CGIAR-commissioned Elsevier Report on Research Performance of CGIAR Research Programs, and others. The IEA concluded that: 1) VCR leadership has "…excellent scientific trajectories […] and both [leaders] enjoy high international reputations and are considered leaders in their fields of expertise"; and 2) the Flagship "has made substantial advances in providing solutions for the risks associated with variability in water supply and with the competing uses of water among sectors. In particular, research on innovative approaches to groundwater management and on the food-water-energy nexus has made significant contributions internationally." The evaluation team also noted that this flagship has a "wide variety of relevant partners, often from the most advanced research groups, but at the same time covering most possible stakeholders," and that such a "diverse range of partners contributed in some focal regions to bridging the gap between agriculturalists and environmentalists by encouraging productive dialogue between the two camps." It was further noted that "The research portfolio is of high scientific quality, the leadership is open to and proactive in expanding an emphasis on gender, and the focus on partnerships is commendable." "Five of the 13 most highly cited WLE publications are mapped to MRV and, in the sample publication assessment, all were ranked as relevant to highly relevant to WLE." It was noted that an important feature of the science of this flagship is "the interest and capacity to tackle issues which are very difficult and debatable to assess rigorously at the global level, such as a critical review of past projections of global water use and scarcity, and a recent assessment of global water pollution."

The VCR Flagship intends to continue on this path of science excellence within the extended FP scope, based on a thorough peer-review process and quality management guidance in partnership contracts.

2.4.1.5 Lessons learned and unintended consequences

The VCR Flagship builds from Phase 1 of WLE on a large and emerging body of work on water variability, scarcity and degradation, competing uses and the water-energy-food nexus emerging, such as:

- Insights into the gendered nature of water resources and variability as a basis for recommendations for enhancing gender-equitable water resources management, including groundwater management (Baker et al. 2015 and Meinzen-Dick et al. 2014).
- Assessment of the potential of underground storage and other ESS-focused/landscape-based solutions to managing water resources variability in South Asia, Southeast Asia and SSA (Altchenko and Villholth 2015; Pavelic et al. 2015);

- Assessment of key threats to future water security (Sadoff et al. 2015);
- Assessment of the role of groundwater depletion for global food security (ongoing);
- New tools and data on ESS approaches (e.g. environmental flow assessments and applications), and on balancing natural and built water infrastructure in the context of the SDG process;
- Assessment of the potential of various institutions and governance mechanisms, such as basin-wide, upstream-downstream schemes of payments for ecosystem services (PES) and groundwater governance, to increase water and food security and reduce environmental degradation (Meinzen-Dick et al. 2014);
- Preliminary insights into the role of a carbon tax on fossil fuels, water and food security (Ringler et al. 2016b), and on the relationship between hydropower, irrigation, water and food security (to be completed by the end of 2016); and
- Assessment of water pollution hotspots with a focus on agricultural nitrogen and phosphorous (IFPRI and Veolia 2015).

The Flagship will not continue work on PES in the Andes as this has been completed, with the successful production of all International Public Goods. VCR will also reduce its work on competing water uses alone; only work with energy sector analyses will be taken forward. WLE has completed much of its work on identification of hotspots for water scarcity, water pollution and groundwater depletion. In Phase 2, the focus will be on co-development and application of solutions for identified hotspots in key AFS breadbasket areas.

Loss of positive aspects of variability is perhaps one risk where unintended consequences could occur, if VCR solutions are widely adopted. Floods, for example, bring significant benefits for both ecology and agriculture. The benefits associated with fisheries and agriculture in large deltaic systems, such as the Mekong Delta, may be one or two orders of magnitude higher than annual costs of flood damage. Thus, management of variability needs to consider both avoiding the costs and optimizing the benefits. VCR collaborates with the FISH CRP through its Flagship on Securing Small-scale Fisheries, where IWMI will lead a CoA on Fish in Multifunctional Landscapes that will include work on the impact of water variability on inland fisheries.

Most importantly, VCR explicitly builds environmental water allocations into its solutions, and such allocations, in turn, explicitly mimic natural hydrological variability to support the maintenance of positive variability impacts, such as seasonal flooding benefiting inland fisheries and flood-recession agriculture.

2.4.1.6 Clusters of Activity (CoA)

The overarching research questions of the two VCR CoAs are: (1) *how far can escalating water-related risks for agriculture and AFSs be reduced sustainably and cost-effectively in a situation of growing competition for natural resources?* And (2) *how can institutional buy-in and support across sectors be catalyzed to overcome technical, policy and institutional barriers?*

Both VCR CoAs will aim to enhance and extend the Phase 1 work of WLE – in scope, scale of acceptance and geography – moving it further along the impact pathway, e.g. 1) from pre-feasibility studies to illustrating the proof of concept with several AFS CRPs; 2) piloting proposed landscape interventions such as various flood capture and storage methods in regions most relevant to the major AFSs; and 3) developing step-by step guidance for large-scale implementation of proposed solutions—with a

particular focus on groundwater. Particular emphasis on groundwater is motivated by the scale of groundwater use that supports agriculture, increasing pressures on this resource, and its role as a buffer against growing climate variability. To that effect, VCR will launch a new **Groundwater Solutions Initiative for Policy and Practice (GRIPP)** to upscale practical and sustainable solutions for groundwater management globally. The initiative aims to: 1) reverse unsustainable management of groundwater that threatens future growth; 2) promote sustainable use of groundwater where untapped potential exists; and 3) advance the understanding of links between groundwater use, surface water flows and ESS. It will engage a range of research, delivery and development partners, relevant WLE flagships, and AFS CRPs in their major production regions. Through GRIPP, VCR will significantly enhance WLE and overall CGIAR focus on groundwater as a resource for food security, and a buffer against risk and variability for both men and women.

Both VCR CoAs will also contribute to unpacking and operationalizing the overall concept of **water security** and its manifestation in selected regions/countries, together with the ESA Flagship, by 1) comparing actual levels of water security in countries; 2) determining the rate and direction of changes in water security over time; and 3) identifying key entry points and investment pathways for improving water security.

CoA 4.1: Managing Resource Variability and Risks for Resilience: Lead Centers: IWMI and IFPRI

Description:

CoA 4.1 advances innovative WLE Phase 1 work on 1) reducing agricultural risks and losses due to floods and droughts; 2) diversifying water storage options and a 'portfolios of options' for enhanced agricultural water availability while safeguarding ESS and livelihoods; 3) introducing unconventional environmental, livelihood and health aspects into reservoir operations; and 4) landscape and basin-scale groundwater/managed aquifer recharge solutions that buffer variability for improved resilience of AFSs. In this CoA, more emphasis will be placed on: 1) the role of aging water infrastructure for human and water security of the rural and urban poor (with an additional focus on financing rural water infrastructure); 2) basin solutions to mitigate urban flooding through community-driven (including indigenous knowledge) and remotely-sensed warning systems; 3) land availability and rights in the practical implementation of landscape-based solutions to temporal water variability; and 4) examination of the overall efficiency of watershed development programs that involve large-scale use of managed aquifer recharge, as well as providing new models of implementation.

CoA 4.1 will co-design, together with CCAFS, basin-wide and regional solutions to mitigate catastrophic flooding and reduce drought impacts, and improve flood-recession agriculture, fisheries and other related ESS through applying community-driven insights (including gender-disaggregated indigenous knowledge), remote sensing-based monitoring and alert systems, weather-index insurance schemes, and new managed aquifer recharge schemes. The CoA will complement approaches pursued in AFS breeding programs, such as supporting the identification of cultivation areas most suitable for crops of various levels of drought tolerance (e.g. rice and wheat) and, in the case of rice, various levels of submergence tolerance as well. The large-scale, managed aquifer recharge work, such as *Underground Taming of Floods for Irrigation (UTFI)*, will support AFS CRPs in the eastern Indo-Gangetic Plains, gradually extending it geographically to other suitable areas in Asia. CoA 4.1 will also examine the impact of resource variability on transboundary water management, and support mechanisms for sharing the risk of variability in transboundary situations, i.e. "sharing adaptation" to climate and water variability and change in transboundary basins and aquifers.

Research questions:

- How can we, in partnership with AFS CRPs, reduce increasing water-related risks (including too much and too little water) to agriculture sustainably and cost-effectively and equitably?
- What is the role of community-driven big data and modern technology (remote sensing, and information and communications technologies [ICT])-based disaster monitoring and warning systems in mitigating these risks in different regions?
- What is the role of innovative ESS-based subsurface storage solutions in buffering water variability, increasing socio-ecological resilience for women and men, and promoting youth contributions to sustainable rural development at large?
- Where, to what extent, and how quickly can such solutions become an alternative to traditional approaches, such as large concrete reservoir construction?
- How can we best combine green (natural) and grey (built) water infrastructure solutions to support water and food security, reduce risk of floods and droughts, and enhance environmental and equitable outcomes?
- What are the local cultural, religious, social and gender barriers that need to be overcome to accelerate the adoption of the above ecosystem service-based solutions in target AFS production areas?

Theory of change and Impact pathways:

The key uptake partners are national and sub-national governments, humanitarian and disaster risk reduction agencies, development banks and investment facilitators (WB, AfDB, ADB, UNISDR, IFAD, WFP). The uptake pathways with local governments (Uttar Pradesh, India, and the Federal Ministry of Agriculture and Rural Development (FMARD), Nigeria, etc.) and banks (WB, IDB) that have been established under Phase 1 will be maintained and extended. The emphasis is twofold: 1) promote innovative partnerships with investment facilitators and banks; and 2) assist national governments to set up more pilots, and streamline VCR solutions into wide-scale policy adoption.

Key outputs:

Detailed water-related disaster risk analyses; policy advice on how to deal with risks in key AFS production areas; operational drought and flood monitoring and alert systems; guidance for basin-wide, ecosystem service-based water storage development plans; international public goods, and contributions to United Nations databases, assessments and safety guidelines; investment plans and scenarios of green and grey water infrastructure; subsurface solutions for flood capture and storage are implemented to establish credible evidence on the technical, social and economic viability of underground solutions in multiple countries and settings, which can then be translated to implementation models/guidelines tailored to specific settings; and barriers to adoption of the above menu of solutions due to land rights, governance and institutions, gender and social differentiation are identified. Outputs will include targeted capacity development programs and scientific publications and presentations to document and disseminate research findings, as well as a variety of communication products, including policy briefs, investment guides, and blog discussions.

Key outcomes:

CoA 4.1 primarily focuses on the first two outcomes listed in *Table 2.4.1*. It also contributes significantly to sustainable groundwater management (outcome [C]). The CoA targets such specifics as “By 2030, policymakers and water agencies adopt investments, policies and institutions to reduce hydrological variability impacts in selected irrigation systems in South and Southeast Asia

by approximately 10%"; and "Investment, policy and institutional changes contribute to up to USD 20 million in avoided damages each year by 2022 in the Ganges Basin alone." It aims to ensure adoption of landscape-based variability management approaches by a minimum of six million households in India and Bangladesh (combined) by 2022, and to contribute to lifting up to three million people out of poverty in the same countries by that year, with additional but smaller outcomes in SSA.

Regional focus:
Major AFS food production areas in South Asia (Nepal, India, Bangladesh, Pakistan), with the primary focus on the Ganges Basin; Southeast Asia (Lao PDR, Thailand, Myanmar and Vietnam); the Volta Basin and the larger West Central African region (Ghana, Burkina Faso, Nigeria); and the Nile Basin countries (Ethiopia, Tanzania). We will also assess the potential for adoption of VCR tools in China, Central Asia and southern Africa (SADC). The above regions encompass both numerous high disaster risk areas with continuing major economic and human losses, and major possibilities for enhancing sustainable groundwater use by rural poor, or subsurface stores for flood capture.

CoA 4.2: Managing Competing Uses and Trade-offs: Lead Centers: IFPRI and IWMI

Description:
CoA 4.2 will assess agriculture as a source of growing natural resource competition, but also as the sector with the largest solution space to ensure resource security. Thus, in Phase 1, this CoA focused on identifying critical areas for engagement through assessing water scarcity, pollution and groundwater depletion hotspots, as well as geographies and organizations that could benefit most from decision-support systems on the water-energy-food nexus. In Phase 2, CoA 4.2 will engage in these critical areas, sometimes with AFS CRPs, to respond to national and regional needs to address risks from increasing resource scarcity for and from agriculture, and to identify policies, institutions and tools for bilateral and multilateral resource trade-offs and nexuses in specific geopolitical contexts, as well as globally. This will be done with partners in WLE and AFSCRPs, and as part of various global initiatives, such as Future Earth and FE2W.

The 'problemshed' of this cluster covers the following topics: 1) inter-sectoral trade-offs which are highly relevant regionally, such as those between hydropower and fisheries, and agriculture and the environment, in the Mekong; 2) water resource and food security implications of rapid solar (versus traditional) energy development at basin and country scales, such as in South Asia; 3) co-management options for grey and green infrastructure that support both food production and wetland ecosystems, and ways to improve reservoir operation with environmental flows and livelihood considerations (Mekong/Niger/Nile/Volta); 4) developing institutions for sustained groundwater management that engage women and men (Africa); 5) market-based water allocation mechanisms and other economic incentives for so-called mature water economies; and 6) water-energy-food nexus solutions in those regions where win-win solutions are feasible.

The CoA will work with the WHEAT, RICE and MAIZE AFS CRPs to identify hotspots (competition, overdraft, pollution, energy variability) and 'sweet spots', where land, water and energy resources are conducive to sustainable intensification of relevant AFSs. In addition, this CoA will dock with the CGIAR Research Program on Policies, Institutions and Markets (PIM) by addressing surface water and groundwater quantity, quality and variability constraints for the Global Futures/Strategic Foresight program of CGIAR. It will also work closely with the WLE ESA Flagship and PIM Flagship 5 on equitable NRM options in WLE regions.

Research questions:

- How can we better manage trade-offs across the water-energy-food nexus, and reduce associated environmental impacts in the context of the SDGs while ensuring that gender and equity dimensions are adequately considered?
- What are the thresholds for sustainable surface water and groundwater use in agriculture, and how can we accelerate the adoption of sustainable water management practices in target AFS food production areas and globally; how can both women and men be engaged?
- What are the technical, policy, institutional and gender-related barriers that need to be overcome to manage surface water and groundwater quantity and quality sustainably on a trajectory of increasing population pressure?
- What tools, institutions and investments support alignment of national and regional plans for energy development with water resource availability and other competing uses?

Theory of change and impact pathways:

The key uptake partners include, amongst others, IUCN and UNEP, as well as global mechanisms that focus on environmental outcomes (e.g. Ramsar Convention). Strong uptake alliances have been developed with multilateral banks and donors/ change agents, such as the German and Indian governments. The CoA directly interacts with the private sector, including hydropower and global water supply companies, and with river basin agencies, such as Nile Basin Initiative (NBI), Mekong River Commission (MRC), and the Volta and Niger basin authorities, where effective. The enabling environment for change will be supported through capacity development and formulation of guidelines.

Key outputs:

1) Provision of policy advice on trade-offs and synergies across water, land and energy resources, targeted at selected basin, national, regional, AFSs and global levels; 2) recommendations for investments in sustainable and equitable groundwater development and management, including institutional arrangements and incentive systems for engagement of women and youth; 3) hydro-economic, water quality and ecosystem service valuation models, basin-wide environmental flow management plans, and related databases and protocols that support relevant SDG targets and scenario analyses for decision makers in sectoral ministries on integrated water-energy development in specific geographies; 4) capacity development programs; and 5) scientific publications and communication products, including blog posts, policy briefs and investment guides.

Key outcomes:

CoA 4.2 primarily focuses on enhanced groundwater management (outcome [C]) and increased sustainability across the water-energy-food nexus (outcome [D]) in *Table 2.4.1*. The CoA targets 10% of total water-energy-food nexus savings valued at a minimum at USD 2 billion across the Ganges, Nile, Volta and Mekong river basins (leveraging billions of dollars in planned infrastructure investments in these regions). Through GRIPP, CoA 4.2, together with CoA 4.1, aims to contribute to realizing at least 1% of the groundwater irrigation potential area in SSA over the period 2017-2022 (1% of this potential is estimated to be 600,000 ha of newly irrigated land, with 3.6 million rural and urban direct beneficiaries, and USD 1.2 billion of total investments leveraged over the above period). Realization of sustainable groundwater management will increase water-use efficiency in the region at least by 5% over current rainfed water management with low yield levels.

Regional focus:
Based on the hotspot analysis for water scarcity, water pollution and groundwater depletion in Phase 1 of WLE, areas of rapidly increasing energy demands and overall food insecurity, as well as ecosystem service degradation, CoA 4.2 will focus on major AFS food production areas: Nile Basin (Ethiopia, Egypt, Sudan); Volta (Ghana); South Asia (India, Bangladesh); and the Greater Mekong Sub region (Vietnam, Lao PDR). There is also an explicit global focus.

2.4.1.7 Partnerships

CGIAR comparative advantage

WLE is a leader in the management of water resource variability through ecosystem service-focused, landscape-scale approaches. There is no precedent globally, where several cohesive solutions to variability and trade-offs were put forward in a short time and some developed to the stage of first pilots. Similarly, WLE is recognized globally for leadership in water-for-food modeling and policy advice, and increasingly for water-energy-food nexus modeling. Furthermore, WLE benefits from the CGIAR presence and strong partnerships with national agencies in core engagement countries, such as India. To maintain a competitive edge, a number of established partnerships outside CGIAR are maintained, and new partnerships are continuously explored. The categorization of partners is not always simple as many are involved with VCR in different roles (*Table 2.2.4)*.

Partners for discovery

Sustainable Water Futures Program of Future Earth and Institute for Water Modelling, Bangladesh, are examples of established research partnerships at global and national scales, respectively. We also collaborate with numerous prime research organizations in target regions as well as in Europe, America and Japan that are co-developing tools and policy mechanisms with VCR.

Partners for proof of concept

These partners include government agencies, local authorities and farmers in target countries, international nongovernmental organizations(NGOs) and think tanks, the disaster risk reduction community, and humanitarian organizations. They are critical in pursuing innovation, testing and using research outputs.

Scaling-up partners

These partners include our long-lasting partnership with the Ramsar Convention, emerging partnerships with hydropower companies in the Mekong, and investment banks that are critical forth provision of funding and resources, capacity building and new solutions

VCR will have strong partnerships with several CRPs, including: 1) RICE and FISH on water variability impacts on production in deltas and floodplains; 2) WHEAT, MAIZE and RICE (coordinated with ESA) on identification of areas for piloting and upscaling of flood- and drought-tolerant crop varieties, through the provision of detailed information on duration, timing and extent of inundation or drought extremity to match with different levels of crop tolerance; and 3) identification of natural resource constraints, hotspots for competition between agricultural and non-agricultural users of land, water and energy, and entry points for increasing resource-use efficiency. VCR builds on a strong partnership with CCAFS, which started in Phase 1.

Table 2.4.2 VCR Partners along the R4D Continuum

Discovery	Proof of concept	Scaling up
Universities in USA, Canada, Europe, Japan and in target countries; Indian Institutes of Technology (IITs); Institute of Water Modelling (IWM), Bangladesh; Regional Research Centers West African Science Service Center on Climate Change and Adapted Land Use [WASCAL], Asian Disaster Preparedness Centre [ADPC]); International Groundwater Resources Assessment Centre (IGRAC); Water Research Commission (WRC, South Africa); Council for Scientific and Industrial Research – Water Research Institute [CSIR-WRI], Ghana; Larger research networks (e.g., International Association of Hydrological Sciences [IAHS], International Association of Hydrogeologists [IAH]; Stockholm Environment Institute [SEI], IIASA, IUCN, WWF, FE2W); the Nexus Initiative under Future Earth and its Sustainable Water Futures Programme; and UNESCO-IHE Institute for Water Education IWMI, IFPRI, CIFOR, WorldFish, AFS CRPs, PIM and CCAFS	Disaster Risk Community of Practitioners; humanitarian organizations, including WFP, Red Cross and UNICEF United Nations University Think Tanks, UNEP, Food and Agriculture Organization of the United Nations (FAO) Global agenda conventions (Ramsar)	Donors, international financial institutions (WB, AfDB, ADB). Basin organizations (Volta Basin Authority [VBA], NBI, MRC, Water Resources Commission [WRC], Ghana) Global processes and conventions (SDGs, UNISDR, Ramsar). Private sector enterprises concerned with managing their production and reputational risks for regional and global benefits (e.g., hydropower companies, food and beverage producers) Local and central governments

2.4.1.8 Climate change

One major global manifestation of climate change is increasing water variability, which affects the availability of water and other natural resources for all uses, including agriculture, and to which the sector needs to adapt. VCR is exceptionally well-positioned to advance its solutions into **adaptation** practice. VCR already has strong links to the global climate change agenda, and to CCAFS, since Phase 1. CCAFS focuses on climate-smart agriculture at large, and smart water management (including resilient water storage, examined by VCR) is part of this. Some research activities were already co-investments from both CRPs. In Phase 2, VCR will continue co-investing with CCAFS on developing and upscaling landscape-based management (e.g. storage, large-scale managed aquifer recharge) and policy (e.g. flood insurance) solutions that alleviate the adverse impacts of water variability. Such co-investment allows these solutions to be diversified and the geography of their application extended. CCAFS funding in Phase 2 may focus on piloting solutions that moderate peaks of extreme floods, while WLE may invest in ways to accelerate surface–subsurface interactions in monsoonal regions. CCAFS components are drawn primarily from CCAFS CoAs 2.1 (Flagship 2 -Climate-smart Practices) and

4.3 (Flagship 4- Climate Services). Besides adaptation to climate change, VCR's focus on the water-energy-food nexus opens new avenues to explore climate change **mitigation** options that benefit agriculture while also enhancing resource-use efficiency across all three sectors.

2.4.1.9 Gender and youth

Increasing water variability, scarcity and degradation have differential impacts on how men and women access and benefit (or not) from water and energy. Variability also affects food prices, with disproportionate impacts on the poor. WLE Phase 1 research in Ethiopia, India and Colombia showed that gender-differentiated ESS can inform development priorities of access to and use of natural resources, and that even where women are disproportionately affected by a loss of ESS (as when groundwater depletion affects domestic supplies), they are not able to respond as they lack knowledge of the underlying biophysical processes related to resource variability. Together with GID, VCR will: 1) examine the potential of gender-equitable institutions to deal with water variability, scarcity and competing uses; 2) suggest mechanisms to improve women's understanding of access to and control over natural resources; and 3) quantify gendered, water-related regulating and provisioning ESS. Through the above, VCR will contribute to women's capabilities to become more resilient. VCR will focus on two gender research questions:

- With increasing variability of and competition for natural resources, how to ensure that women are not adversely affected?
- How to ensure that VCR solutions to variability and trade-offs benefit women, and engage them in co-development, testing and practical implementation of these solutions?

Some VCR innovations may appeal to youth to implement, which may facilitate youths' contributions to sustainable rural development. 'Flood harvesting' farms, closer engagement with mobile ICT to improve resource-use efficiency, and developing community-based disaster alert systems may be of particular interest to younger generations of farmers. VCR will, therefore, focus on one youth-related research question:

- How to ensure that VCR solutions benefit youth, and how best to engage youth in co-development, testing and practical implementation of such solutions?

2.4.1.10 Capacity development

VCR plans to undertake capacity development (CapDev) along the impact pathway with multiple levels of learning, particularly innovative learning materials and methods, strengthening institutions, and supporting the capacity to innovate. First, VCR will focus on capacity strengthening of river basin organizations, and water resources and agricultural ministries, on water variability and managing associated risks. Second, VCR will strengthen the capabilities of water, agriculture and energy ministries in selected countries to address trade-offs associated with single-sector development strategies, using integrated tools and approaches. Third, VCR will work toward increasing the capacity of hydropower companies and basin managers to innovate through co-development of decision-support tools and governance mechanisms to help manage grey and 'green' water infrastructure conjunctively. Those activities also include innovative approaches, such as multi-stakeholder dialogues. Fourth, VCR's groundwater initiative, GRIPP, will contain a capacity development program that includes curriculum development and online courses utilizing instructional design for enhanced knowledge and insights on groundwater management, as well as innovative learning materials and web-based platforms. In each case, VCR is cognizant of a gender differential in training needs, and will

identify specific entry points to ensure enhanced engagement by both women and men. At the AFS level, VCR will provide tools and capacity on: 1) identifying areas for piloting and upscaling of flood- and drought-tolerant crop varieties; 2) identifying areas of current and increasing future competition between agricultural and non-agricultural users of land, water and energy; and 3) addressing natural resource constraints to AFS CRPs. Elements of the CGIAR capacity development framework addressed by the VCR are summarized in *Table 2.4.3*.

Table2.4.3 VCR Capacity Development Elements (darker shading - higher focus)

Element	VCR CoA 4.1	VCR CoA 4.2
11. Needs assessment and intervention strategy		
12. Learning materials and approaches		
13. Develop CRPs and centers' partnering capacity		
14. Develop future research leaders		
15. Gender-sensitive approaches		
16. Institutional strengthening		
17. Monitoring and evaluation		
18. Organizational development		
19. Research on capacity development		
20. Capacity to innovate		
Key:	High	Medium

2.4.1.11 Intellectual asset and data management

The flagship will adhere to the *IWMI and WLE Open Access and Data Management Policy* submitted to the Consortium Office in June 2015, as part of its compliance with CGIAR's Open Access and Data Management Policy. All VCR research products are considered International Public Goods to maximize their impact, in a manner that fosters the CGIAR SLOs. To that end, all datasets, applications and tools developed are being published and made available online. IWMI hosts a large open water information portal focusing on larger-scale, thematic datasets, tools and model setup (http://waterdata.iwmi.org/). VCR is the key contributor to this open access system. It also collaborates with the ESA Flagship on aspects of 'big data', and contributes to the solutions' platform being built by WLE. Another key dissemination pathway of the VCR outputs is its publications. The share of those publications from the current (MRV) flagship, which are open access, has been continuously growing to around 70% at present. VCR intends to have open access publications close to 100% by the start of Phase 2 of WLE in January 2017. The WLE blog and center web sites are used to promote publications, as well as discussions on the critical aspects of VCR research, and get them wider afield. All partners will be supported to commit to the CGIAR Principles on the Management of Intellectual Assets and the CGIAR Open Access and Data Management Policy. This will be ensured, amongst other means, through contractual agreements. Budget support for continuous increase of open access publishing will be factored into joint proposals.

2.4.1.12 Flagship management

VCR Flagship management is based on years of productive collaboration between the two lead centers of the flagship (IWMI and IFPRI), including five years of Phase 1 of WLE. A co-leader from each of the two centers will each take the responsibility for one CoA, and will contribute to management of the other CoA as required. The VCR Flagship co-leaders are jointly responsible for driving the flagship

strategy and achieving its plan within the boundaries of Windows 1 and 2 (W1/2) allocations. Regular virtual meetings will keep the core partners fully engaged. For large cross-flagship, cross-CRP initiatives, such as GRIPP, a leader has already been identified. The flagship will be represented in the WLE Management Committee through its two co-leaders. Flagship management will be subject to the proposed CRP performance assessment framework and performance monitoring plan.

2.4.2 Flagship Budget Narrative

2.4.2.1 General Information

CRP Name	Water, Land and Ecosystems
CRP Lead Center	IWMI
Flagship Name	Flagship Project 4: Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR
Center location of Flagship Leader	IWMI & IFPRI

2.4.2.2 Summary

Table 2.4.4 Flagship Budget Details

Total Flagship budget summary by sources of funding (USD)

Funding Needed	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	1,618,632	1,699,564	1,784,542	1,873,769	1,967,457	2,065,831	11,009,797
W3	0	0	0	0	0	0	0
Bilateral	7,600,000	7,980,000	8,379,000	9,216,900	10,138,590	11,152,449	54,466,939
Other Sources	0	0	0	0	0	0	0
	9,218,632	9,679,564	10,163,542	11,090,669	12,106,048	13,218,280	65,476,736

Funding Secured	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Assumed Secured)	1,618,632	1,699,564	1,784,542	1,873,769	1,967,458	2,065,831	11,009,797
W3	0	0	0	0	0	0	0
Bilateral	2,432,280	825,331	266,005	16,519	0	0	3,540,136
Other Sources	0	0	0	0	0	0	0
	4,050,913	2,524,895	2,050,547	1,890,288	1,967,458	2,065,831	14,549,933

Funding Gap	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Required from SO)	0	0	0	0	0	0	0
W3 (Required from FC Members)	0	0	0	0	0	0	0
Bilateral (Fundraising)	-5,167,719	-7,154,669	-8,112,995	-9,200,381	-10,138,590	-11,152,449	-50,926,803
Other Sources (Fundraising)	0	0	0	0	0	0	0
	-5,167,719	-7,154,668	-8,112,995	-9,200,381	-10,138,590	-11,152,449	-50,926,802

Total Flagship budget by Natural Classifications (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
Personnel	3,215,430	3,382,557	3,557,607	3,877,766	4,226,641	4,611,920	22,871,924
Travel	626,438	657,539	690,202	756,092	827,395	905,588	4,463,256
Capital Equipment	60,691	63,727	66,910	73,505	80,751	88,717	434,304
Other Supplies and Services	2,164,759	2,275,527	2,392,239	2,613,414	2,859,377	3,124,060	15,429,378
CGIAR collaborations	47,582	49,785	52,101	58,383	63,260	69,473	340,588
Non CGIAR Collaborations	1,872,751	1,957,881	2,047,291	2,230,686	2,432,190	2,653,638	13,194,439
Indirect Cost	1,230,976	1,292,545	1,357,188	1,480,821	1,616,430	1,764,880	8,742,843
	9,218,627	9,679,561	10,163,538	11,090,667	12,106,044	13,218,276	65,476,713

Total Flagship budget by participating partners (signed PPAs) (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
IWMI	7,084,569	7,438,798	7,810,737	8,525,961	9,309,414	10,167,755	50,337,236
IFPRI	2,056,806	2,159,647	2,267,629	2,475,274	2,702,728	2,951,923	14,614,009
IWMI - WLE	77,256	81,118	85,174	89,433	93,905	98,600	525,489
	9,218,631	9,679,563	10,163,540	11,090,668	12,106,047	13,218,278	65,476,727

Within the VCR Flagship, W1/2 funds will be prioritized to address three areas of work: addressing water variability in the Gangetic Plains where rural poverty remains large and the potential to impact poverty and food security through water variability management is high; second, evidence based policies and institutions to enhance groundwater management in Sub-Saharan Africa; and third, solutions across the water-energy-food nexus in the Mekong and Nile river basins where both demands for and impacts of this research are large. VCR will leverage work with AFS CRPS in Phase 2 by directly working with WHEAT and RICE CRPs in key water-stressed breadbasket areas for these crops to ensure that new crop breeds will be able to withstand future water variability and other climatic stresses. We will also further leverage our work with other Integrating CRPs, such as CCAFS on insurance for water variability.

VCR will develop bilateral resources and leverage W1/2 funds to generate high-impact evidence-based research and policy analyses on reducing water variability in key food producing regions; to identify green and grey infrastructure management options that increase human well-being while maintaining the environment; to enhance groundwater's role in food security and environmental sustainability; and to identify solutions across the water-energy-food nexus in selected sites. To do so, WLE will spend approximately 35% of the total funds on CGIAR staff salaries, approximately 22% will be used to for collaborating partners critical to achieving key outputs and outcomes, 24% of resources go to supplies and services, and 13% towards overhead. Approximately 35% of the resources will be spent on activities in Sub-Saharan Africa, with the remainder used for cross regional work, development of tools and global analyses, and capacity building. As the Flagship is designed, the funding will be approximately the same between CoA 4.1 (water variability) and 4.2 (competing uses and the nexus), with IWMI as the primary partner in CoA 4.1 and IFPRI the primary partner in CoA 4.2.

The highest risks for this flagship is instability of funding and increase of costs due to change in the external and internal environment. The Program Management Unit with guidance from the Lead Center will review risks on a quarterly basis and track impacts on budgets, and adjusting as appropriate. The major risk in budgeting is the limited knowledge available of the funding landscape over the course of the next six years. We have addressed this risk by diversifying our Phase 2 funding strategy toward a broader range of donors; by prioritizing research activities with large potential impacts,

planning to add areas of research only as funding availability increases, and co-financing joint work with AFS CRPs.

A second potential risk relates to uptake of research results by targeted end-users. We believe that WLE and CGIAR have developed close levels of engagement in countries, regions and global agencies targeted by VCR. We will also ensure engagement of actors early on and involve them throughout the research process. We have reserved approximately 20% of resources for engagement with collaborators. The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the bilateral funding mentioned in this budget will be developed. The success of using partnerships will largely depend on the consistency of bilateral funding.

The breakdown of costs by targets, sub-IDOs and outcomes is stated in the PIM tables and budget.

The components of benefits are, home leave, pension, vehicles, housing, educational allowance, and health insurance. Each center working as part of this program has clear policies and procedures with regards to each of the above cost components which may differ from center to center and category of employment (national, regional, international, etc.). The policies vary among partner centers and are based on local laws and needs.

2.4.2.3 Additional explanations for certain accounting categories

The supplies and services are budgeted as per the costing principles laid out in Financial Guidelines 5 issued by the Consortium Office.

The cost can be broadly categorized into two categories –

1. Research Support and Quality and Coordination costs: Services or research support costs for a CGIAR Centre include research oversight, facilities (or occupancy costs) and general services like rent, utilities, IT, Phone/Fax etc. Other costs include project oversight, data management and depository, and output quality control which are not fully charged on common budget lines.

2. The calculation of charge out rates is based on CGIAR Financial Guideline Series No 5 whereby costs that are not directly research related are treated as research support. The cost of the services is allocated to benefiting projects based on utilization of these services by research staff. Utilization is measured by the number of direct labor hours incurred by research staff while providing direct research support under each project.

The direct costs include consulting services, professional services, publications or subscriptions, conferences/workshops, communications, postage and other miscellaneous costs which are essential for providing the resources to conduct the planned activities and achieve the targeted outcomes. The estimation of the costs has been determined using the phase 1 costs as a baseline.

2.4.2.4 Other sources of funding for this project

VCR is developing a very broad funding strategy which was initiated in phase I and encompasses traditional bilateral donors as well as private foundations, the private sector, multilaterals and national governments. VCR has had success with all these types of donors.

VCR has a clear strategy to adjust if funding is not available as planned that prioritizes three areas of work: first, addressing water variability in the Gangetic Plains where rural poverty remains large and

the potential to impact poverty and food security through water variability management is high; second, evidence based policies and institutions to enhance groundwater management in Sub-Saharan Africa and third solutions across the water-energy-food nexus in the Mekong and Nile river basins where both demands for and impacts of this research are large.

2.4.2.5 Budgeted costs for certain key activities

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
Gender	1,080,000	Both CoAs of the VCR will allocate on average of about 10% of their budget to gender-specific research while a much larger percentage will go into integrating gender and gender sensitive research. The research will be laid out in a three-year gender plan which will include a dedicated budget. The following have already potentially been identified for specific funding: 1) an analysis of how VCR solutions benefit women and men in South Asia; 2) analysis of how women can be engaged in co-development, testing and practical implementation of VCR solutions to variability and trade-offs in Asia and target countries in Sub-Saharan Africa; and 3) entry points in groundwater management for closing the gender gap. An example of an already funded bilateral activity is the gendered assessment water-energy-food nexus challenges and solutions in the Eastern Nile region with a focus on Ethiopia.
Youth	540,000	Within CoA1 VCR will study options to support youth employment in agriculture through their engagement in piloting flood harvesting farms and ICT applications in agriculture and disaster management. CoA 1 will support in the analysis such business opportunities and strengthen the related policy support for more youth engagement in rural farming. VCR will also support under both CoAs, the analysis of how groundwater development promotes (or not) youth engagement in agriculture. The overall budget share in support of youth is expected to be around 5-10%.
Capacity development	1,278,000	VCR will contribute significantly to the training and training manuals development of landscape based solutions in the Eastern Gangetic Plains, the Mekong and the Nile basins, contribute to training materials on weather insurance, and work with government agencies and implementers to co-develop policy-and impact-relevant toolkits and other training materials. VCR will also continue to produce international public goods, building on those developed in WLE Phase I, including decision support systems and modeling tools, such as those on Environmental Flows, Decision Support Systems, and large-scale databases for use by researchers and policymakers. VCR staff will likely spend 10-15% of their time on

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		capacity building activities, while collaborators are likely engaged to a similar extent.
Impact assessment	162,000	Impact assessments will be built into project activities as appropriate and in line with WLE's overall evaluation and impact assessment strategy (see Annex 3.5 on RBM). VCR plans to implement impact assessments and learning for both groundwater and water variability management activities. Flagship leader time will be used to implement these reviews as qualitative assessments. For the strategic new GRIPP program, funds will be set aside for a more formal impact assessment. We will also seek funds for impact assessment from established sources, e.g. the International Initiative for Impact Evaluation. Time allocations for impact assessments as part of the broader work on Monitoring, Evaluation, Impact Assessment and Learning (MEL) will use up to 10% of the time of each Flagship Leader and 5% of the time of Project Leaders will be allocated, including reporting and oversight.
Intellectual asset management	208,800	Compliance with the CGIAR Principles on the Management of Intellectual Assets is a task of each WLE partner center and backstopped by the Lead Center Legal officer and Business Development Director, covered by Supplies and Services budget line.
Open access and data management	90,000	Compliance with the CGIAR Open Access and Data Management Policy is a task of each WLE partner center, and not funded by individual flagships. However, flagships will encourage researchers to budget in proposal resources to cover OA/OD, like open access fees for articles; database membership fees; server and hardware costs. Staffing costs will be covered by a combination of personnel costs and supplies and services.
Communication	540,000	The resources required for Knowledge Management and Communication (KMC) are budgeted in each VCR project, funded by W1/2/3 or bilateral. VCR knowledge products will include materials for use in development processes, such as participatory videos, press releases, radio and TV interviews, policy briefs, blog pieces, decision support systems, and academic books and papers. It will also include engaging with stakeholders including participating in policy level discussions and for engaging in key events at the national, regional and global levels. As the focus on KMC at flagship level is on communicating and engaging stakeholders, WLE KMC will involve uptake/communication staff based in participating Centers leading the VCR. The Flagship will also work closely with program level KMC on strategic communications planning and implementation.

2.4.2.6 Other

The indirect costs in this budget includes costs for the support service units like HR, Finance, and Administration etc. In case there is a sudden decrease of funding. Indirect costs will remain at a higher rate as it will take time to make adjustments. The Indirect cost rate is based on Financial Guideline 5 of CGIAR Cost allocation guidelines.

The highest risks with regards to this project is are instability of funding and increase of costs due to change in external and internal environment. The Program team under the leadership of the Lead center will be reviewing the risks on a quarterly basis and ensure that budgetary adjustments are tracked due to these risks.

The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the Bilateral project's mentioned in this budget will be approved without any variance. Partnerships, which is one of the most important components in the proposal, is are mainly budgeted under bilateral project's and are a measure to minimize risk arising from the fluctuations in windows funding.

Inflation is considered in the costs at 2.63% which is based on the average IMF projections for the next six years. The major costs are incurred in USD and therefore the risk in foreign currency exposure is insignificant.

2.4.3 Flagship uplift Budget

Outcome Description	Amount Needed	W1 + W2 (%)	W3 (%)	Bilateral (%)	Other (%)
Outcome 3.4: Improved institutional capacity within 15 cities leads to the adoption of IUWM principles and actions to harmonize rural and urban water demands	5,377,300	50	0	50	0
Outcome 3.5: Improved institutional capacity for safe agricultural water use reaching 0.5m wastewater using farm households	8,603,600	50	0	50	0
Outcome 3.6: Awareness created on organic soil rehabilitation options via RRR leading to action for 1m ha of tea, palm and tree plantation soils in South Asia and East Africa	5,874,800	50	0	50	0

2.5 WLE Flagship 5: Enhancing Sustainability across Agricultural Systems (ESA)[38]

2.5.1 Flagship Narrative

2.5.1.1 Rationale and scope

To realize the potential medium- and long-term benefits of agricultural intensification, *sustainability* must be given a high priority. This is also essential to achieve the newly adopted Sustainable Development Goals (SDGs). It is critical to identify opportunities and interventions that can transform the current low productivity and degradation of many smallholder agro-ecosystems to being sustainable, highly productive, and more equitable in terms of the distribution of benefits. This requires shifting away from single commodity, single sector or single-scale approaches. It also requires making men, women and youth major stakeholders in natural resource management (NRM), in order to improve their lives and to ensure lasting change. Furthermore, as shown in CPWF and Phase 1 of WLE, it needs to acknowledge and incorporate factors outside the agriculture sector that have impacts upon it, and the beneficial services that ecosystems provide.

The ESA Flagship aims to catalyze this shift by providing research evidence at a landscape scale to support real-life development decisions and investments across commodities, sectors and scales. The Flagship will draw from evidence generated by other CRPs, WLE's thematic flagships and the core gender and inclusive development (GID) theme, and other sources to identify and test ways to scale up and scale out sustainable intensification. The WLE Theory of Change (ToC) addresses the missing links between research and uptake, and recognizes that trade-offs are inherent in decisions on sustainable intensification. ESA will provide a better understanding of these links, and insights into the potential trade-offs and how to navigate them. This will add significant value to both WLE and the wider CGIAR portfolio. The research carried out in the ESA Flagship is fundamental to delivering improved NRM and ecosystem services as envisioned by the SRF.

This Flagship is WLE's main interface between its thematic flagships and core theme (RDL, LWS, RUL, VCR, and GID) and four targeted AFS CRPs (DCL, FTA, Livestock, and RICE)[39]. The work carried out under this Flagship will contribute directly to achieving the CGIAR's Intermediate Development Outcomes (IDOs) under System-Level Outcome (SLO 3) (enhanced natural capital, enhanced benefits from ecosystem services, and sustainably managed ecosystems). It will specifically contribute to: sub-IDO 3.2.2 (more productive and equitable management of natural resources); sub-IDO 3.2.1 (agricultural systems diversified and intensified in ways that protect land and water; sub-IDO 3.2.3 (enrichment of plant and animal diversity for multiple goods and services); sub-IDO 3.3.1 (increased resilience of agro-ecosystems and communities); and IDO 3.3.2 (enhanced capacity to deal with climate risks) (see *Table 2.5.1* below). It will support the CGIAR's response to several societal grand challenges, including climate change, competition for land, soil degradation, and overdrawn water supplies. This work will also contribute directly to achieving several SDGs - 2, 3, 5, 6, 13 and 15, and indirectly to others, including 7, and more importantly, it will look across the SDGs to identify synergies and avoid unintended consequences in one having an adverse consequence on achieving another.

[38] All acronyms are defined when first used and then summarized in Annex 3.14.

[39] WLE is taking a sequential approach to engaging with the AFS CRPs with an aim to work with all appropriate AFS CRPs as budgets develop over the second phase.

While there is a growing body of agro-ecosystems research, the uptake and practical application of emerging results requires not only good science, but a clear understanding of the institutional, political and socioeconomic drivers of change as well as the interactions, feedbacks and trade-offs between different services and the broader social-ecological interactions that produce them (Mooney et al. 2013; Carpenter et al. 2009)[40]. WLE posits that building the resilience and long-term viability of agri-food systems from field through landscape levels requires connecting people and agro-ecosystems under an explicit sustainability framework to **understand, assess, monitor and influence agricultural transitions** to increase their contributions to multiple SDGs (*Table 2.5.1*).While there are many productivity and sustainability indicators known at farm level and within particular farming systems, creating and applying cross-sectoral and cross-scale indicators is a critical challenge. Building on the ecosystem and resilience framework developed in Phase 1 of WLE, we will draw on sustainability frameworks and indicators developed by others (e.g. Hinkel et al. 2015; Bogdanski et al. 2015; FAO 2013; A4S 2015) to co-develop with AFS CRPs a pragmatic approach to operationalizing progress towards sustainability and landscape multi-functionality.

WLE recognizes that moving agro-ecosystem research outcomes into policy is complex and requires engagement with a wide range of stakeholders, including the private sector. Therefore, the Flagship will both employ decision support and analytical tools and methods, and conduct and facilitate integrated research with the four target AFS CRPs. These tools, methods and research partnerships build decision-making capacity and offer a suite of scalable agro-ecosystem interventions that can be used by decision makers in different scenarios, including crises. Through development and application of decision science approaches, ESA will directly support development decision makers as they make decisions, while fully recognizing and considering the data limitations, risks and uncertainties they face. The Flagship is also fully cognizant of the special role women and youth can play, and will, with GID, identify opportunities and enhance their capabilities to engage. This will enhance CGIAR's capacity to influence decision processes aiming to address critical developmental challenges in the CGIAR target countries and WLE's broader focal regions.

2.5.1.2 Objectives and targets

The objective of the ESA Flagship is to identify and test ways to promote sustainable intensification at scale in specific regions, bringing together the comparative advantages of WLE's flagships and partner AFS CRPs. The ESA Flagship will primarily support improved NRM and ecosystem services (SLO 3). *Table 2.5.1* shows key **outcome targets** set by the ESA Flagship in support of the SRF 2022 targets, and the total budget needed to achieve those targets. *Figure 2.5.1* shows the targeted impact pathways. Through the scaling of sustainable intensification focusing on the roles of women, men and youth, ESA will contribute to achieving the 2022 SRF outcome target: "5% increase in water- and nutrient-use efficiency in agro-ecosystems, including through recycling and reuse", and "30 million people of which 50% are women are assisted to exit poverty", "55 million hectares (Mha) of degraded land area restored", and "reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO_2-e".

[40] All references are listed in Annex 3.15

Table 2.5.1 Budget per Sub-IDO Contribution and Related Outcome Target

CoA	Main SLO and IDOs addressed per outcome	Key countries	Outcomes	2022 Targets	Budget (USD '000)
5.1 and 5.2	Sub-IDO 3.2.1: More productive and equitable management of natural resources (SDG 5)	Bangladesh, Burkina Faso, Ethiopia, Ghana, India, Kenya, Nigeria, Tanzania, Uganda, Vietnam	Agricultural land, water, and ecosystem service productivity is equitably increased with particular attention to female farmers and youth	100 NARES and national universities (ca. 5,000 scientists) trained by 2022 in WLE-generated solutions for sustainable agricultural intensification of AFS	$8,415 11%
5.1	Sub-IDO 3.2.2: Agricultural systems diversified and intensified in ways that protect land and water (SDGs 6 and 15)	Bangladesh, Burkina Faso, Ethiopia, Ghana, India, Kenya, Nigeria, Tanzania, Uganda, Vietnam	Adoption of WLE sustainability indicators and frameworks by governments and the private sector	Formal inclusion of research-based sustainable agro-ecosystem management practices in policy and implementation programs in at least 16 countries in targeted Asian and African countries plus two global agreements	$19,126 25%
5.1	Sub-IDO 3.2.3: Enrichment of plant and animal diversity for multiple goods and services (SDGs 1, 2, 3, 7 and 15)	Bangladesh, Burkina Faso, Ethiopia, Ghana, India, Kenya, Nigeria, Tanzania, Uganda, Vietnam	Stakeholders are using decision-support tools to identify interventions and options to improve management of resources	Ten countries are utilizing ESA-developed scenarios, trade-off analysis and equity assessment tools in SDG M&E	$19,126 25%
5.1	Sub-IDO 3.3.1: Increased resilience of agro-ecosystems and communities (SDGs 2, 3 and 5)	Bangladesh, Burkina Faso, Ethiopia, Ghana, India, Kenya, Nigeria, Tanzania, Uganda, Vietnam	Increased governmental and private sector capacity to implement sustainable intensification (SI) practices and develop SI policy	Ten countries are utilizing ESA-developed scenarios, resilience and risk analysis tools in SDG investment planning	$21,421 28%
5.2	IDO 3.3.2: Enhanced adaptive capacity to climate risk (SDG 6 and 13.3)	Bangladesh, Burkina Faso, Ethiopia, Ghana, India, Kenya, Nigeria, Tanzania, Uganda, Vietnam	Increased governmental and private sector capacity to implement SAI practices and develop SI policy	ESA decision support for sustainability and scaling embedded in global sustainability curricula, including that of NARES with FAO/UNEP	$8,415 11%
Total Budget (6 years)					**$76,505**

2.5.1.3 Impact pathway and theory of change

ESA will collaborate with the other WLE flagships, the GID theme, and four AFS CRPs to target national and regional research users and policymakers, investors in development such as international financial institutions, global dialogues aimed at promoting sustainable agricultural development, and other water and land users that influence the management of natural resources. The Theory of Change (ToC) seeks to

ensure that sustainable intensification is recognized as a key foundation for long-term productivity (Garbach et al. 2016). To accomplish this, ESA will engage the major actors and provide tools, capacity strengthening and practical solutions to implement sustainable intensification from farm to landscape scales in equitable and affordable ways, and to manage trade-offs and synergies effectively. Capacity development is an integral part of the impact pathway that enables the uptake of solutions and creates opportunities to develop, adapt and apply them. ESA recognizes that applying the tools and solutions for intermediate and longer term outcomes will require sustained capacity, and therefore integrates capacity development as an enabling factor along the impact pathway.

Recognizing that many decisions are neither transparent nor improved simply through increased information, ESA will also undertake environmental, institutional, and political economy analyses in conjunction with PIM (Policies, Institutions and Markets CRP) and the AFS CRPs. We will use this analysis to engage decision makers, through the work on decision analysis in CoA 5.2, and through forums, dialogue processes and working with and through think tanks. These analyses and engagements will support decision making to identify, within multiple scenarios, the most promising pathways to move research into policy and to learn from previous success stories. As an integral part of this process, ESA will regularly monitor and adjust, when appropriate, its assumptions and impact pathways. With the support of GID, ESA will actively look at ways to break down barriers and develop capabilities to enable women and youth to participate actively in and benefit from better management of natural resources.

The adoption of the sustainability framework and its implementation is a special challenge. More than 100 countries have National Sustainable Development Strategies and at least 170 voluntary sustainability standards are being implemented by the food and agriculture industry (FAO 2013). However, developing and implementing an integrated approach to analyzing sustainability dimensions specific to achieving the SDGs through agricultural intensification, and integrating them at scale in development or business strategies, is a major challenge. ESA will refine, in partnership with AFS CRPs, pragmatic tools to measure sustainability and build from existing sustainability frameworks.

To do this, we are learning from the early participation of potential next-users. We will involve public and private sector stakeholders engaged in agricultural intensification in our research from the design stage. In addition, we are learning from our ongoing efforts to build on FAO's new strategic program on Sustainable Food and Agriculture and the universal framework for Sustainability Assessment of Food and Agriculture systems (SAFA). Capacity development required to implement the sustainability framework is an important consideration. ESA will work with the partner AFS CRPs and our research partners on the ground to identify the capacities needed to realize the goal of a widely applicable framework at national, regional and global levels. To develop this framework further, we will draw from a number of partners, and also specifically from FAO's extensive experience with sustainability frameworks.

Uptake partners: ESA's immediate uptake partners are the AFS CRPs, specifically DCL, FTA, Livestock and RICE. Partnerships with the AFS CRPs will be supported by the work in ESA's activity clusters, and strengthened by ESA's integrating role across WLE flagships and the gender core theme. National and regional organizations make up a crucial set of uptake partners, drawing on well-developed relationships with key change agents formed over the last 12 years, beginning with the CPWF and strengthened in the focal region work of WLE in Phase 1. ESA will also work closely with international organizations to facilitate uptake and avoid duplication of efforts, including FAO, IFIs, IUCN, UNEP and other partners working on sustainable development, especially the implementation of SDGs. The private sector is also recognized as a key emerging uptake partner as companies are increasingly concerned to minimize their social and ecological footprint, reduce risks to supply chains from degradation, and benchmark sustainability compliance. ESA will work with commercial entities that lack the necessary tools, science or capacity to accomplish this at scale. Examples of our primary uptake partners are listed below in

Section 2.5.1.6 on the CoAs. *Figure 2.5.1* is a visualization of the ESA Impact Pathways linking the ESA CoAs through to their contributions to achieving the SLOs and SDGs. As demonstrated by the arrows at the bottom of the figure, we recognize that multiple learning and feedback loops are essential to successfully move outputs to outcomes.

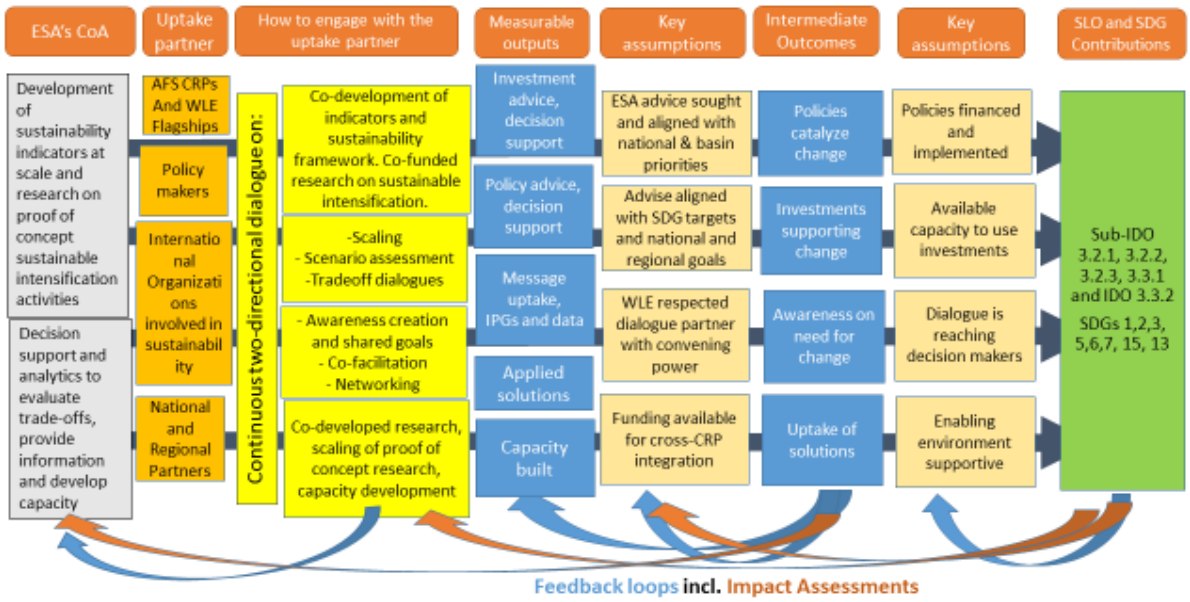


Figure 2.5.1. ESA Impact Pathway

2.5.1.4 Science quality

WLE has contributed to advancing the recognition of agriculture's central role as a critical provider of a range of ecosystem services that are central to human well-being in addition to food security. Highlights have been summarized by the independent evaluation of WLE, for example, "*WLE is producing outcomes at the regional and global levels that contribute effectively to the sustainable management of land, water, and ecosystems.*" (IEA 2016). As an integrating flagship, ESA will build on the strong scientific reputation of WLE's four thematic flagships and collaborate with the AFS CRPs and external partners to co-develop a sustainability framework and indices. ESA's decision-support tools will build on the Decision Analysis and Information Systems Research Theme in Phase 1. In addition, both CoAs will draw lessons from ESA's predecessor, Integrating Ecosystem Solutions into Policy and Investment (IES), and the 33 focal region projects and three innovation fund projects housed under it, all of which used the ESR framework and a strong focus on gender as their starting points.

How ESA will advance the science of sustainable intensification

- Develop tools to support decision making and the evaluation of impacts through a sustainability lens, based on co-developed indicators drawing from global and regional datasets.
- Continue to develop a sustainability framework with the AFS CRPs to understand, assess, monitor and influence agricultural transitions in targeted landscapes.
- Produce novel methods of linking technical and policy research and engaging with decision makers at different scales.

- Develop novel ways of enabling youth and women to become major active participants in natural resource management.
- Develop new tools and technologies supporting sustainability in large-scale agricultural and conservation investments.

Research team qualifications

The ESA team members are all recognized as global experts in their respective fields, and bring together a range of multi-disciplinary and scientific skills. These include agricultural systems and environmental modelling science, political and economic analysis, ecology, biodiversity and ecosystem services, landscape systems science and mapping, mapping and targeting tools, environmental economics, decision analysis, policy research, scenario analysis, climate science, and gender research. The core team includes 10 researchers from Bioversity, CIAT, IWMI, ICRAF, IFPRI, Stanford University, UNEP TEEBAgriFood, FAO, and UNESCO-IHE. All the core members have strong publication records, including in top tier journals such as *Nature*, *Science* and *PNAS* (see Annex 3.7). They also have proven management and development experience in all the focal countries of the Flagship complemented by engagement and leadership in key global initiatives, indicating the team's capacity to assure the scientific quality and strategic research direction of ESA.

WLE's science quality was rated as very good by IEA (2016): "*The number of publications being generated is high and the research outputs examined were similarly overall of a good to very good standard with some examples of excellent, world-class research published in high impact journals. Among WLE staff there are a number of outstanding researchers who are recognized internationally as leaders in their fields."* ESA science quality will be monitored through partners' records of research performance (citation index, etc.), and partner global/regional recognition. Each participating research partner has its own peer-review processes, based on its respective quality control mechanisms, which will be incorporated into project contracts. High-quality science debates have occurred between scientists from inside and outside CGIAR on the WLE Blog, including around Sustainable intensification, Ecosystem Services and Resilience and land sharing or sparing.

The team includes especially strong capacity in decision analysis and sustainability. WLE has been leading such work in its first phase, producing tools and publications on this topic (Shepherd et al. 2015; Naeem et al. 2015). ESA partners with some of the world's leading decision analysis institutions (e.g. Hubbard), model developers, development practitioners, and global sustainability initiatives (SDSN, IPBES, GEF, Future Earth), enabling it to access, aggregate, and put into operation decades of practical, political, and academic experience. WLE and partners have also been actively developing and implementing multi-stakeholder engagement approaches and negotiation support (e.g. its SHARED, Mesoamerican, Basin Authorities, Green Growth Corridors, Water Funds). This collective experience, with its specific strengths in landscape-based approaches, is particularly relevant to CGIAR's mandate in demonstrating the contribution of natural resources and ecosystem services (SLO3) to sustainable development within the context of the CGIAR SLOs 1 and 2.

Monitoring and evaluation (M&E) is essential for ensuring scientific quality. M&E helps identify both weaknesses and strengths in methods and data collection. WLE has an established monitoring, evaluation and learning (MEL) process that was developed in Phase 1. This includes regional impact pathways and highly commended experience running both commissioned and competitive work (IEA 2016). In Phase 2, ESA will draw from this experience to work with the AFS CRPs and the WLE thematic flagships to commission small seed projects directly from proven performers. Criteria used to evaluate projects will include: contribution to program's impact pathway, novelty of research question, contribution to SLO outputs and outcomes, ability to address gender issues, and potential for scaling. The WLE online planning

and reporting system is designed to allow projects to adjust their impact pathways and to document self-reflection and learning. Annual reflection and science workshops inviting key stakeholders and the AFS CRPs will further foster collaboration and help ensure rigor.

2.5.1.5 Lessons learned and unintended consequences

Despite their inherent complexity, integrated and multi-disciplinary approaches can provide solutions to complex issues such as sustainable intensification (Liu et al. 2015). WLE's experience with the Ecosystem Service and Resilience (ESR) Framework in Phase 1 demonstrated both the value of an integrated approach and its challenges (IEA 2016). The ESR framework provided a guide for WLE projects and partners to work under, and proved to be a useful tool for capacity development on ecosystem services and resilience. Uptake and communication were challenges, with strong opinions expressed on the framework's utility, both for and against (IEA 2016). These were largely overcome through open dialogue – which yielded fruitful advances both to improve the application of the framework to agricultural development, and to expand the sustainability mandate of agricultural development. Building on these lessons, ESA will merge this framework into a more sustainability-oriented framework in close collaboration with a broad range of uptake partners and the AFS CRPs. By leveraging the comparative advantage of CGIAR in target countries, ESA will bring new perspectives on sustainability from farm through landscape scales, and seek to influence decision makers to make agriculture central to sustainable development policies.

While the principles established by ESR remain important, the Flagship will adopt a broader sustainability perspective that embraces considerations of how to both: 1) reduce environmental impacts of agricultural intensification; and 2) increase agriculture's contribution to achieving sustainability targets (reduced emissions, improved soil, water, and air quality, biodiversity conservation and connectivity, increased productivity and reducing inequity). As part of this, under Phase 1 we developed integrated regional impact pathways work that build on research, networks and partnerships initiated by the CPWF and continued through WLE Phase 1.

The potential unintended consequences of introducing new crops or practices at landscape scales to biodiversity is significant. New crops, for example, may require more fertilizer or pesticides that lead to resource degradation. Agricultural intensification often requires increased water withdrawals and/or alteration of natural flow regimes which can have significant impacts on downstream ecosystems and associated ecosystem services. Developments in other sectors also influence agricultural development and the ecosystem services. ESA will work with AFS CRPs and other partners to identify and address these challenges. At the same time, ESA recognizes that working on complex agro-systems rather than single crops or value chains is enormously complex, and benefits can be difficult to communicate and achieve in the short term. ESA will draw on lessons from both the sustainable intensification projects in the four focal regions and the innovation fund currently being implemented by WLE. That research is testing and strengthening WLE's ecosystem-based approach and innovative work on gender at a landscape scale. These national and regional efforts were developed through a series of regional consultations.

A key lesson from this regional approach has been the strength of leveraging WLE's partnerships on the ground to move outputs to outcomes. Through seed funding in CoA 5.1, these partnerships will continue to be used to leverage resources of WLE, AFS CRPs and other investors, including those working across other sectors. Another important lesson learned is the importance of finding effective ways to communicate the benefits and costs of sustainability to decision makers to enable them to make the best decisions over both the long and short term. Key also was the experience researching gender in the focal regions, where working from the beginning with partners on gender questions in their projects allowed for significant innovative gender research to be undertaken.

2.5.1.6 Clusters of Activity (CoA)

The ESA Flagship is central to WLE's integrating CRP (ICRP) mandate and will focus on landscapes where one or more AFS CRP and WLE flagships are working. ESA integrates WLE flagships, GID, AFS CRPs and national research partner strengths to frame and test innovative and practical agricultural land, water and other natural resource management solutions, while managing trade-offs to achieve sustainable intensification. This will be done through two interlinked CoAs.

CoA 5.1: **Operationalizing Sustainable Intensification at Scale** is a cross-CGIAR initiative to refine, test and benchmark sustainability indicators at scale for agri-food production under a jointly operationalized sustainability framework. The research and indicators in this CoA will be informed by the decision analysis and analytics in CoA 5.2.

CoA 5.2: **Decision Support and Analytics** will support activities across disciplines to provide decision makers with a suite of tools to identify intervention options, synthesize alternative outcomes from different investment decisions and evaluate trade-offs, as well as developing research and practitioner capacity to use these tools under various scenarios.

Table 2.5.2 shows the specific linkages between ESA, WLE flagships and partner AFS CRPs developed with extensive communication and coordination, resulting in agreed commitments to collaborate.

Cluster of Activities 5.1 Operationalizing Sustainable Intensification at Scale

Supported by FAO, UNEP TEEBAgFood and other development partners, CoA 5.1 has two primary functions. First, it will identify and validate mutually agreed sustainability indicators in close collaboration with WLE flagships and AFS CRPs. The output will be targeting and valuation tools that facilitate quantification of positive and negative externalities of agricultural intensification at scale (see TEEB 2015).

The framework and tools will enable assessment of trade-offs and synergies across sectors and levels to enable stakeholders to compare, from field to landscape level, investment impacts of AFS and related agricultural land and water management scenarios. Comparisons of indicators across agri-food systems will be emphasized, aiming at monitoring progress and providing national-level decision support for investments to achieve the SDGs. The tools will be co-developed, and where appropriate co-financed, with Livestock, RICE, FTA and DCL through activities by joint multi-disciplinary working groups convened by WLE.

Table 2.5.2 Specific Linkages between ESA, WLE Flagships and DCL, RICE, FTA and Livestock

CRP	Flagship	Countries	Specific Linkages
DCL	FPs 1, 4, 5	Nigeria, Tanzania, Ethiopia, India	Focus on water-use efficiency, and resilience to variable environmental conditions in scaling out of agro-ecological systems. Through decision analysis approaches, contribute to foresight and *ex-ante* impact assessment work. Draws on expertise from WLE's LWS flagship.
RICE	FPs 1, 2	Nigeria, Tanzania, India, Bangladesh, Myanmar, Vietnam	Focus on intensification and multi-functionality of flood pulse rice ecosystems through irrigation management. Draws on expertise from WLE's LWS and VCR flagships.
FTA	FPs 3, 4	Burkina Faso, Ghana, India	Focus on the role of agroforestry interventions on large-scale hydrological processes (quality and quantity),

CRP	Flagship	Countries	Specific Linkages
			fragmentation, and ecosystem services. Contribute to *ex-ante* impact analysis for agroforestry interventions at farm to landscape scale. Draws expertise from WLE's RDL and VCR flagships.
Livestock	FPs 4, 5	Tanzania, Ethiopia, India, Vietnam	Focus on sustainability and nutritional security during intensification of mixed crop-livestock systems and transitions toward more industrial systems. Draws on expertise from WLE's RDL flagship.

Second, leveraging the work in WLE flagships and using the sustainability framework described above, CoA 5.1 will test and refine prioritized integrated crop, livestock and NRM solutions at scale in jointly selected geographies where WLE and its partners have a comparative advantage (*Table 2.5.2*). For example, AFS CRPs develop and test improved crop varieties and agronomic practices to increase the production and profitability of farming systems. WLE adds value to the integrated value chain paradigm of the AFS by assessing landscape and ecosystem-scale impacts, including influences beyond the agriculture sector, to evaluate how improved productivity/profitability can be achieved, by: 1) leveraging ecosystems and their services (MEA 2005); 2) reducing or avoiding unacceptable environmental impacts (Liu et al. 2015); and 3) achieving greater equality (Raworth 2012).

CoA 5.1 uses a range of mechanisms to drive inter-CRP collaboration. These include:

- Cross-regional workshops to create knowledge products, including compendiums of best practice and joint briefing notes on NRM topics of mutual interest with AFSs.
- Joint seed funding with AFS CRPs so that CGIAR researchers can work to catalyze innovative studies building on WLE's experiences.
- Continued coordination of regional dialogue and engagement platforms to support inter-CRP collaboration in landscapes on well-defined NRM and agricultural productivity challenges.

Geographical focus:

Countries	Regions	Global
Tanzania, **Ethiopia**, Burkina Faso, Ghana, **Nigeria, India, Bangladesh**, Nepal, **Vietnam** and Myanmar	East Africa, West Africa, South Asia and Southeast Asia	Yes

Note: Countries in **bold** are primary.

Research questions:

- What environmental and livelihood indicators, attributes and criteria that are accepted and can be operationalized by relevant stakeholders, should be used to monitor sustainable intensification of agri-food systems?
- What incentives (e.g. payments or benefit sharing) are needed to reach sustainability, intensification, and equity at scale? What are the political and economic leverage points that can help achieve this? What types of legal and compliance mechanisms will help foster change?

- Which combinations of NRM and crop interventions, and other ecosystem services are the most promising in terms of returns on investment at different scales, under different climate change and population growth scenarios? Who will be the actual beneficiaries and what are the potential trade-offs?

- What role does gender and youth play in these leverage points, and how can power relations influence, or capabilities be developed for, achieving equitable outcomes of sustainable intensification?

Theory of change and impact pathways:
CoA 5.1 will take advantage of DCL, Livestock, RICE and FTA, and WLE flagships' ToCs and impact pathways and established uptake partners. WLE's advantage in applying the sustainability framework in the CGIAR and more widely, is its focus on developing and using indicators at higher scales. Using R4D approaches, WLE and AFS CRPs, will work with partners that express interest in collaborating from the beginning of the research process. Partners will be drawn from national and regional governments, development agencies and the private sector to encourage buy-in and scaling of proof of concept. This inclusive approach ensures that the research is closely aligned with the priorities of decision makers, thereby making the research relevant and attractive to AFS CRPs and wider partners.

Key outputs:

- Jointly designed sustainability framework, including indicators and tools for benchmarking and monitoring sustainable intensification across scales.

- Verification trials for testing the framework and promising solutions with crop-and livestock-based CRPs and the private sector.

- A gender and youth toolkit that provides both an evidence base to demonstrate the benefits, costs and trade-offs of incorporating equity and youth considerations into decision-making, and research-based advice on needed policy changes and implementation strategies.

- Full cost accounting of both positive and negative externalities of prioritized AFS intervention scenarios and related impacts on achieving SDG targets when scaled.

- Innovative knowledge products linked to the solutions platform developed in AC 2 to provide decision makers with a suite of options to build resilience.

Outcomes:
1) Adoption of WLE sustainability indicators and frameworks by governments and the private sector, evidenced by implementation of research-based sustainable intensification practices on five Mha in Asia and Africa by 2022; 2) stakeholders are using decision-support tools to identify interventions and options to improve management of natural resources, evidenced by ten countries utilizing ESA developed scenarios, trade-off analysis and equity assessment tools; 3) increased governmental and private sector capacity to implement SI practices and develop SI policy, evidenced by ESA decision support for sustainability and scaling embedded in global sustainability curricula including that of NARES with FAO/UNEP; and 4) agricultural land, water, and ecosystem service productivity is equitably increased with particular attention to female farmers and youth, evidenced by 100 NARES and national universities (ca. 5,000 scientists) trained by 2022 in WLE-generated solutions for sustainable agricultural intensification of AFS.

Cluster of Activities 5.2 Decision Support and Analytics

This CoA will capitalize on the increasing availability of new, low-cost data streams and respond to a paradox in many countries: the emergence of 'big data' applications and the gap in their use for decision making on sustainable transformation of agro-ecological landscapes. Working across and beyond WLE's focal landscapes, in partnership with WLE flagships and participating AFS CRPs (*Table 2.5.2*), CoA 5.2 will assemble the datasets, information and models necessary to address critical grand challenges on which WLE works. This CoA will facilitate access to relevant big data sources and coordinate, organize, and catalogue the application of big data techniques across the program in line with the CGIAR Open Access and Open Data Management Policy and linking to the CGIAR Coordinating Platform on Big Data and ICT.

CoA 5.2 will contribute to an innovative decision support toolbox for WLE and its partners, consisting of: 1) decision analysis approaches for quantitative *ex-ante* impact analysis of specific decisions; 2) information and monitoring platforms and indicators on water, land and ecosystems; 3) an integrated 'solutions' platform that will act as a resource for CGIAR to present the consequences of alternative and often competing development pathways and decisions; and 4) a repeatable, dynamic tool that visually synthesizes alternative outcomes from different investment decisions and evaluates trade-offs.

Extending work initiated in Phase 1, decision science approaches (Hubbard 2014) will be applied to support complex and risk-laden decisions that are central to addressing challenges in focal landscapes where limited information is available (Fenton and Neil 2012; Luedeling et al. 2015; Shepherd et al. 2015).

Virtually all decisions in agricultural systems are made with incomplete systems understanding and imperfect information. Decision analysis can provide guidance by offering probabilistic impact projections for alternate decisions, and can highlight decision-specific knowledge gaps through Value of Information analysis. Decision analysis can also help direct more detailed decision-support research to where it is most needed, and through its explicit focus on decisions, can help assess the potential outcomes of policy interventions. Examples of policy questions addressed with decision analysis methods include whether a government should implement land tenure reform; whether to enact legislation to reduce aquifer over-pumping; or whether tree-based land restoration should be promoted to achieve sustainable land management. Concrete case studies already under way include business case analyses on the nutritional impacts of tree-based smallholder systems in East Africa, and the costs and benefits of small reservoirs in West Africa.

Innovations will be tested with impact models developed in close collaboration with decision-making entities. These models attempt to emulate the real decision dilemmas decision makers frequently face, raising the prospects that research results are given more serious consideration in decision making. Decision analysis is widely used in many contexts, where risky decisions on complex systems must be made with limited information. CoA 5.2 will pilot and adapt these proven methods in the context of agricultural development, where they have rarely been applied so far.

CoA 5.2 will also further develop information systems designed under Phase 1 that use appropriate informatics approaches to process disparate, large datasets and indicators produced by WLE's flagships and partners. Acknowledging the lack of decision-support tools that effectively integrate across disciplines and sector boundaries and scales, ESA will develop a tool that visually synthesizes alternative outcomes of competing investment decisions. This trade-off evaluation and visualization tool will build on cases and research outputs from WLE and other CRP flagships. It will provide a foundation for integrating biophysical and socioeconomic research evidence from across the entire CRP portfolio, and present the information in a graphical format accessible to policymakers. CoA 5.2 will support the generation and management of Big Data and related tools across WLE by providing support for data

access, collection, curation and management in line with the CGIAR OA/OD Policy, and to feed outputs into the CGIAR Big Data and ICT Coordinating Platform.

Geographical focus:

Countries	Regions	Global
Tanzania, Kenya, Uganda, Ethiopia **Burkina Faso, Ghana** and other countries as opportunities permit	East Africa, West Africa and other regions, as opportunities permit	Yes

Note: Countries in **bold** are primary.

Research questions:

- How can decision science approaches be used effectively to produce business cases for policies or projects, for spatial targeting, prioritizing interventions, and deriving indicators for monitoring and evaluation?
- How can decision analysis assist in *ex-ante* appraisal of the costs and benefits of proposed activities that accrue to women and youths in society?
- How can the advances in new, low-cost data streams and technologies be exploited to design information systems which effectively support decisions on agricultural interventions and natural resource management at multiple scales (linked directly to the sustainability framework in CoA 5.1)?

Theory of change and impact pathways:

Research leads to impact wherever it is used to improve the decisions of change agents. While there are new open data initiatives to improve access to data relevant to management of land, water and agricultural systems, the major remaining challenge is how to effectively design and deploy data systems to improve stakeholder decisions — data becomes information only at the point that it can be used to inform decisions and behaviors are changed as a result. CoA 5.2 research into Decision Support will address this gap with science-based approaches to identifying and prioritizing interventions, determining how to measure the impact of interventions on development outcomes, and calculating the value of the research itself. By continuing to work with partners who contributed to the development of tools for decisions identified under Phase 1, CoA 5.2 will directly support specific decisions by developing tailored decision models together with partners involved in making these decisions.

Experiences from Phase 1 will be adapted and used to further refine the approaches, in particular, the participatory model building procedures, to enhance their uptake by development decision makers. CoA 5.2's decision analytics approaches will be closely aligned with the challenges involved in development decision making, with a particular link to the framework and indices developed in CoA 5.1, increasing the likelihood that the work will enable WLE's development partners to make better-informed choices, which will help promote more sustainable and equitable development.

Key outputs:

- Catalogue and open access database of all (socioeconomic and biophysical) data produced across the program.
- Datasets, tools and platforms for water and land accounting and agro-biodiversity monitoring.
- Solutions platform and tools for assessing and visualizing trade-offs in solutions.

- Approaches for participatory decision modeling, including decision makers and stakeholders, spatial intervention targeting, and *ex-ante* impact models for decisions related to the thematic mandates of WLE and CGIAR;
- Curriculum for strengthening capacity in decision analysis among research partners, development decision makers and practitioners.

Outcomes:
1) Increased governmental and private sector capacity to implement SI practices and develop SI policy, evidenced by ESA decision support for sustainability and scaling embedded in global sustainability curricula including that of NARES with FAO/UNEP; and 2) agricultural land, water, and ecosystem services productivity is equitably increased with particular attention to female farmers and youth, as evidenced by 100 NARES and national universities (ca. 5,000 scientists) trained by 2022 in WLE-generated solutions for sustainable agricultural intensification of AFS.

2.5.1.7 Partnerships

Partnerships are an essential component of ESA's work, and their importance will continue to grow as the program develops. ESA will collaborate with partners at all stages of its impact pathway, starting with discovery to influence decision making, and shifting mind-sets on how people view agricultural development and the environment, and eventually to achieving positive impacts (see *Table 2.5.3*). ESA will build on long-standing relationships that began during CPWF or even earlier, while others such as with AgMIP were formed for the purpose of phase 2 or through recent work. These partnerships have been important in moving outputs to outcomes, as demonstrated by IEA (2016) *"Partners appeared to be good choices with good reputations in science for development. Methodologies proposed were innovative and/or appropriate and demonstrated effective integration of new knowledge from research with stakeholder involvement to deliver locally-relevant solutions."*

ESA's implementation partners have been identified through several processes including open and competitive calls conducted under ESA's predecessor flagship, regional stakeholder meetings, and WLE's participation in site integration meetings. IEA (2016) stated that, "*Overall, partners had a very positive opinion about the effectiveness and utility of their WLE partnership experience*."

Table 2.5.3 ESA Partners along the R4D Continuum

Partner Type	WLE Centers and CGIAR Programs	Discovery/ Upstream	Proof of Concept/ Pilot	Scaling Out (Downstream)
ESA Flagship	**WLE, Bioversity** CIAT, ICRAF, IWMI, IFPRI DCL, RICE, FTA, Livestock	IPBES, Global Landscape Forum, national research institutes and universities	FAO, World Bank, Governments of Ethiopia, Kenya, Ghana, Burkina Faso, Myanmar, Bangladesh, Vietnam, Nepal, Tanzania, India	World Bank, IFAD, GEF, Basin Authorities, UNEP, UNDP, IUCN, NGOs
CoA Specific	CoA 5.1 **Bioversity, WLE**	UNEP TEEBAgFood, NatCap, USAID Sustainable Innovation Lab, AgMIP	DCL, RICE, FTA, and Livestock CRP	National and regional agencies. Private sector. Stockholm Food

Partner Type	WLE Centers and CGIAR Programs	Discovery/ Upstream	Proof of Concept/ Pilot	Scaling Out (Downstream)
				Forum (EAT Foundation), Volta Basin Authority, Ramsar
	CoA 5.2 **ICRAF, IWMI**	Hubbard Decision Research, Queen Mary University of London, Center for Development Research FAO, UNESCO-IHE	Economics of Land Degradation initiative, GIZ, DCL, FTA	National and regional governments

Drawing from WLE's partnership strategy, ESA has identified four types of critical partners:

1. **Research partners** will be at the heart of the ESA flagship and will co-develop and provide scientific input into the work in CoA 5.1 and CoA 5.2. They will also act as early peer reviewers to ensure scientific quality and novelty remain high. These partners include: WLE flagships, AFS CRPs (specifically DCL, FTA, Livestock and RICE), Bioversity, ICRAF, CIAT, IFPRI, FAO's Strategic Program 'Sustainable Food and Agriculture', and international organizations and academic institutions, including AgMIP, UNEP TEEBAgFood, Hubbard Decision Research, Queen Mary University of London, Makerere University, Volta Basin Authority, Lao PDR National Agriculture and Forestry Research Institute , WWF, IUCN, ZEF Center for Development Research, UNESCO-IHE and NARS.

2. **Development organizations and IFIs** will help to scale-up research and be a key funding source for moving the seed projects in CoA 5.1 beyond proof of concept. These partners include: Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES), the World Bank, the International Finance Corporation, IFAD, Rockefeller Foundation, the African Development Bank, and the Asian Development Bank.

3. **The private sector** will be an important partner to ensure the business sustainability and practicality of solutions proposed. Examples include UNILEVER, Syngenta, ABInBev, Coca-Cola, Nestle, Danone and Mars. WLE will continue to engage with other private sector partners involved with non-agricultural sectors, but whose decisions impact NRM and agro-ecosystems. The newly founded EAT Foundation, of which the CGIAR CEO sits on the Science Advisory Board, and to which WLE contributes work on Landscape and Seascape Multi-functionality, will serve as an important catalyst of engagement with the private sector.

4. **National and local governments** will be involved from the beginning of the research design to improve the practicality of the tools and approaches and improve the opportunities for uptake into decision making. These partners include: the local and national governments in the countries targeted in *Table 2.5.2*. These partners are also key capacity development partners and will be the focus of much of the research in CoA 5.2. To gain access to key stakeholders among these partners, we will draw from our research partners to leverage contacts across appropriate ministries and departments. WLE will also draw on its history of collaboration with basin authorities as a means of cross-sector engagement and intervention negotiation.

2.5.1.8 Climate change

It is generally agreed that about 25% of carbon dioxide emissions are produced by agricultural sources, mainly deforestation, the use of fossil fuel-based fertilizers, and the burning of biomass. Food systems account for 19-29% (Vermeulen et al. 2012) of global GHG emissions coming primarily from N_2O, CH_4 and CO_2 from the preproduction, production and postproduction of food along the value and supply chains. ESA research will support finding ways to reverse these negative trends, adapt and build resilience to climate risks, and mitigate climate change.

In collaboration with CCAFS, CoA 5.1 will address the challenges of climate change through the development of sustainability indicators and integrated research that specifically address mitigation, adaptation and resilience challenges for millions of people in the focal countries. These indicators and the research will leverage the comparative advantage of the objectivity of CGIAR and selected AFS CRPs to promote a shift from business-as-usual agricultural practices to sustainable intensification for sustainable and equitable growth.

CoA 5.2 will develop approaches for planning agricultural development in the face of risks and uncertainties, many of which arise as a consequence of climate change. Through the use of probabilistic simulations and strategies to consider the full range of possible future dynamics, in terms of both climatic and non-climatic drivers, CoA 5.2 will offer pragmatic solutions for including climate change among other considerations in development planning. This will facilitate activities of the targeted AFS CRPs.

2.5.1.9 Gender

With the support of WLE's GID core theme, ESA has prioritized the importance of understanding how access to, and benefits from, natural resources change within different AFS CRP interventions, and assessing power relations and capabilities to identify potential change agents and leverage points to advance gender equity. Barriers to, and potential opportunities for gaining access to, and participating in decision making on natural resources, and employment of women on an equal basis with men in NRM, with equal pay and opportunities for training and advancement, are all part of a common set of sustainability indicators (FAO 2013). ESA will explore the roles of gender and equity in sustainable intensification, not only as a question of social justice, but considering its potential to increase net benefit flows (Picketty 2014) though the links and feedbacks on agro-ecosystems. ESA's operational and analytical scale will enable it to work across agri-food systems to support achieving gender equality through:

- Assessing how AFS innovations shift the balance of access to, and benefits from, natural resources, ecosystem services, and food and nutritional security.
- Assessing current power relations and capabilities to identify potential change agents and leverage points to advance equality.
- Analyzing the political economy and its barriers to supporting men and women, in order to identify entry points and solutions to address bottlenecks and obstacles.

Closely linked to gender considerations, significant proportions of the populations in the areas where WLE works are below the age of 25. As highlighted in WLE's *Youth Strategy* (Annex 3.4), this presents an enormous opportunity for capacity development and research-based innovations to support the transition to sustainable agricultural practices. Specifically, and collaborating with AFS CRPs, ESA will carry out research to identify options for youth to engage in, and benefit from, innovative sustainable intensification business opportunities.

2.5.1.10 Capacity development

The only way ESA can achieve promised outcomes and impacts is to adopt an implementation approach based on co-design and co-development of solutions, supported by a strong capacity development strategy. Leveraging partners, WLE flagships, and AFS CRP knowledge, ESA will co-design specific capacity development opportunities to facilitate the uptake of AFS and ICRP tools and expertise to solve specific problems. A key emphasis will be to increase the capacity of research partners to use modeling software to assess the impacts of alternative interventions on food and environmental security, and to negotiate solutions given complex trade-offs and potential synergies and dependencies. ESA will also prioritize identifying opportunities to enhance capacities to develop solutions aimed at achieving gender equality. In addition to identifying specific capabilities needed, ESA will train women scientists and managers.

Capacity development (CapDev) will be done largely through regional fellowship programs, annual fora on sustainability aspects of food production for knowledge sharing, policy dialogue, and training of trainers and partners. The aim of these activities will be to enhance research capacity through institutional strengthening and to improve the capacity of decision makers to utilize research knowledge in trade-off analysis, as well as developing capacity to communicate and apply integrated research-based solutions. In addition to these traditional capacity development approaches, ESA will build on extensive work done under Phase 1 to raise awareness, share experiences, and create space for dialogue to develop the capacity of those framing and taking development decisions. The CapDev elements of the CGIAR framework addressed by the ESA, as shown in *Table 2.5.4*, are: learning materials and approaches (both CoAs); develop future research leaders (both CoAs); institutional strengthening (CoA 5.2); and capacity to innovate (CoAs 5.1 and 5.2).

Table 2.5.4 ESA Capacity Development Elements (darker shading - higher focus)

Element	ESA CoA 5.1	ESA CoA 5.2
1. Needs assessments and intervention strategy		
2. Learning materials and approaches		
3. Developing CRPs' and centers' partnering capacity		
4. Develop future research leaders		
5. Gender-sensitive approaches		
6. Institutional strengthening		
7. Monitoring and evaluation		
8. Organizational development		
9. Research on capacity development		
10. Capacity to innovate		
Key:	High	Medium

2.5.1.11 Intellectual asset and data management

ESA is committed to the effective and efficient management of intellectual assets at every stage of the CRP life cycle, and to widely disseminate research outputs for maximizing impact. The Flagship will adhere to the IWMI and WLE Open Access and Data Management Policy that was submitted to the Consortium Office in June 2015 as part of compliance with the CGIAR Open Access and Data Management Policy. ESA Intellectual Assets management treats research results and products developed under WLE as International Public Goods, to maximize their impact. A critical dissemination pathway for maximizing impacts of ESA outputs will be the solutions platform to be developed in CoA 5.2. This platform will include remote sensing and decision analysis tools. ESA will also leverage the partnerships and shared

projects with WLE Flagships, the AFS CRPs and national and regional partners to disseminate results widely. All ESA partners, to the extent that they are able to align, will be supported to assume accountability for the appropriate implementation of the CGIAR Principles on the Management of Intellectual Assets and the CGIAR Open Access and Data Management Policy. The support will be based on three activities: 1) participation of all research partners in the project management life cycle; 2) targeting joint data platforms and publications; 3) contractual commitment to open access; and 4) budget support for open access publishing factored into joint proposals.

2.5.1.12 Flagship management

ESA Flagship management builds on existing collaboration between WLE and Bioversity. The Flagship co-leaders (from WLE and Bioversity) will take joint responsibility for CoA 5.1; CoA 5.2 will be led by ICRAF and IWMI with the flagship management contributing where required. The ESA Flagship co-leaders are jointly responsible for driving the flagship strategy and achieving its plan within the boundaries of W1/2 allocation and where possible through influencing bilateral work to engage with its goals and approaches. Regular virtual meetings with partners and the AFS CRPs will keep key stakeholders fully engaged. The Flagship will be represented in the WLE MC through its two co-leaders. Flagship management will be subject to the proposed CRP performance assessment framework and Performance Monitoring Plan.

2.5.2 Flagship Budget Narrative

2.3.2.1 General Information

CRP Name	Water, Land and Ecosystems
CRP Lead Center	IWMI
Flagship Name	Flagship 5: Enhancing Sustainability across Agricultural Systems (ESA
Center location of Flagship Leader	Bioversity & IWMI

2.5.2.1 Summary

ESA, like other WLE flagships, utilizes an Activity Based Costing approach. In the case of ESA, funds are concentrated in geographic locations where interactions and engagements with AFS CRPs is strongest, and best able to scale CGIAR results to impacts. Activity-based accounting aims to keep indirect costs and overheads low; however, specific efforts to leverage W1/W2 funding to scale both partnerships and results will also be important and encouraged to increase the flagship's return on investment. The Flagship places high value on co-development and co-execution of projects with development and policy partners, with nearly half of the budget supporting direct engagement with large-scale development investments, and another 25% focused on collaboration with AFS CRPs. The main focus on gender for this flagship is in improving the capacity of decision-support models and scaling activities to account for and anticipate impacts of land-use planning and AFS scaling on equitable access to knowledge and physical resources. Our approach to youth is in the development of temporally explicit models and decision-support tools that facilitate the inter-generational impacts of landscape scale interventions and planning on resource quantity and quality. We expect that 20-30% of the budget will be allocated to the question of equitable access in both space and time of scaled AFS interventions. As with the CRP, in general, ESA has a significant dependence on bilateral funding, generated by all partners.

Table 2.5.5 Flagship Budget Narrative

Total Flagship budget summary by sources of funding (USD)

Funding Needed	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2	1,779,196	1,868,155	1,961,563	2,059,641	2,162,623	2,270,755	12,101,936
W3	0	0	0	0	0	0	0
Bilateral	8,986,481	9,435,805	9,907,595	10,898,354	11,988,190	13,187,009	64,403,436
Other Sources	0	0	0	0	0	0	0
	10,765,677	11,303,960	11,869,158	12,957,995	14,150,813	15,457,764	76,505,367

Funding Secured	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Assumed Secured)	1,779,196	1,868,156	1,961,564	2,059,642	2,162,624	2,270,755	12,101,937
W3	0	0	0	0	0	0	0
Bilateral	2,485,017	766,814	518,224	7,342	0	0	3,777,397
Other Sources	0	0	0	0	0	0	0
	4,264,213	2,634,970	2,479,788	2,066,984	2,162,624	2,270,755	15,879,334

Funding Gap	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
W1+W2 (Required from SO)	0	0	0	0	0	0	0
W3 (Required from FC Members)	0	0	0	0	0	0	0
Bilateral (Fundraising)	-6,501,464	-8,668,991	-9,389,371	-10,891,013	-11,988,190	-13,187,009	-60,626,039
Other Sources (Fundraising)	0	0	0	0	0	0	0
	-6,501,464	-8,668,991	-9,389,371	-10,891,013	-11,988,190	-13,187,009	-60,626,039

Total Flagship budget by Natural Classifications (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
Personnel	3,608,680	3,762,201	3,871,207	4,082,110	4,308,821	4,531,528	24,164,550
Travel	660,898	837,524	825,224	799,695	851,185	1,010,379	4,984,908
Capital Equipment	27,896	29,291	30,755	33,796	37,144	40,823	199,708
Other Supplies and Services	2,208,999	2,162,411	2,270,082	2,549,841	2,874,622	3,783,964	15,849,921
CGIAR collaborations	18,585	19,328	20,098	23,606	25,247	27,982	134,848
Non CGIAR Collaborations	2,968,419	3,157,384	3,449,155	3,937,902	4,381,852	4,236,851	22,131,565
Indirect Cost	1,272,196	1,335,819	1,402,634	1,531,044	1,671,939	1,826,235	9,039,869
	10,765,673	11,303,958	11,869,155	12,957,994	14,150,810	15,457,762	76,505,352

Total Flagship budget by participating partners (signed PPAs) (USD)

	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Total
IWMI	3,222,141	3,383,248	3,552,411	3,880,706	4,240,485	4,634,825	22,913,818
Bioversity International	2,540,796	2,667,836	2,801,228	3,056,789	3,336,679	3,643,267	18,046,599
CIAT	864,517	907,742	953,130	1,041,211	1,137,740	1,243,541	6,147,882
ICRAF	2,357,624	2,475,505	2,599,280	2,839,494	3,102,745	3,391,284	16,765,935
IFPRI	700,127	735,133	771,890	842,814	920,518	1,005,662	4,976,145
Tier 2 Partners	995,270	1,045,034	1,097,285	1,198,350	1,309,088	1,430,443	7,075,472
IWMI - WLE	85,199	89,459	93,932	98,629	103,560	108,738	579,519
	10,765,674	11,303,957	11,869,156	12,957,993	14,150,810	15,457,760	76,505,350

The major risk to the expenditure plans outlined is the limited knowledge available at this early stage of the funding landscape over the course of the next six years. WLE plans to put in place a results-based management system that will include performance-based funding allocation. The W1/W2 and bilateral

funding projections in the budget are based on the best estimates available. Given the dynamic experienced over the last two years, funding availability will almost certainly fluctuate compared to what is provided here, which will affect the activities that the Flagship is able to complete, expected outcomes, and the corresponding classification of costs. The W1/2 allocations will be essential to coordinate the Flagship efforts and to set priorities as far as possible. The breakdown of costs by targets, sub-IDOs and outcomes is stated in the PIM tables and budget.

The components of benefits are: home leave, pension, vehicles, housing, educational allowance, and health insurance. Each center working as part of this program has clear policies and procedures with regards to each of the above cost components which may differ from center to center and category of employment (national, regional, international, etc.). The policies vary among partner centers and are based on local laws and needs.

2.5.2.2 Additional explanations for certain accounting categories

Supplies and services are budgeted as per the costing principles laid out in CGIAR Financial Guidelines 5 issued by the Consortium Office. The costs can be broadly categorized into two categories:

1. Research Support and Quality and Coordination costs: Services or research support costs for a CGIAR center include research oversight, facilities (or occupancy costs) and general services such as rent, utilities, IT, phone/fax, etc. Other costs include project oversight, data management and depository, and output quality control which are not fully charged on common budget lines.

2. The calculation of charge out rates is based on CGIAR Financial Guideline 5, whereby costs that are not directly research related are treated as research support. The cost of the services is allocated to benefiting projects based on utilization of these services by research staff. Utilization is measured by the number of direct labor hours incurred by research staff while providing direct research support under each project.

The direct costs include consulting services, professional services, publications or subscriptions, conferences/workshops, communications, postage and other miscellaneous costs, which are essential for providing the resources to conduct the planned activities and achieve the targeted outcomes.

2.5.2.3 Other Sources of Funding for this Project

ESA's funding strategy draws from successes in Phase 1 and encompasses traditional bilateral donors, foundations, the private sector and national governments. This includes successes with the Australian Department of Foreign Affairs, Trade and Development, USAID and the Rockefeller Foundation. A new strategy in phase 2 will include co-development of proposals with AFS CRPs and national organizations to scale up joint seed funded activities in CoA 5.1. In a reduced funding environment, ESA will look at options to focus more tightly on specific AFS CRPs in condensed geographic areas and prioritize work where development needs and opportunities are the greatest, and where existing CGIAR infrastructure already exists as well as targeted fund-raising campaigns.

The Flagship has a significant dependence on bilateral funding – in a reduced budget environment, the flagship would redouble its already focused fund-raising efforts on paired development investments.

2.5.2.4 Budgeted costs for certain key activities

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
Gender	1,380,000	ESA will allocate on average about 15% of its budget to gender research. Examples for gender-specific research are: 1) improved decision support, including in MESH, that better account for gender-specific losses and gains in access and use of natural resources; and 2) targeting methodologies to develop and direct gender-relevant technologies and governance options to regions where women are specifically at risk. A specific outcome will be a toolkit providing both an evidence base to demonstrate the benefits, costs and trade-offs of incorporating equity considerations into decision-making surrounding sustainable intensification, and research-based advice on needed policy changes and implementation strategies. The Flagship, with the help of GID, will develop a multi-year gender plan, and seek bilateral support to implement activities that explicitly support the planning and execution.
Youth (only for those who have relevant set of activities in this area)	690,000	As with gender, ESA will focus approximately 15% of its budget on research related to youth. Examples of ESA youth-specific actions focus on the impacts of scaling AFS intervention and other landscape scale natural resource and ecosystem service interventions on intergeneration access to the natural resources that underpin sustainable agriculture. This includes: 1) development of specific decision support tools that facilitate a priori projections and scenarios on natural resource stocks and flows over decadal time periods; 2) integration of long term resilience-based measures in natural resource and ecosystem service decision making tools, and 3) research on reward systems that incentives the engagement of youth in agriculture as an enviable livelihood option.
Capacity development	1,633,000	ESA approaches capacity support and development by focusing on solutions-oriented activities. It features specific co-development of research and policy via direct engagement with agricultural, health, water and environmental ministries in target countries. In Phase 1, this direct engagement facilitated identification of CGIAR AFS innovations and their integration into landscape scale decision-making and planning. The next phase will build on lessons and best practices from WLE's first phase, in which we utilized both virtual course materials such as NatCap's MOOC on ecosystem service assessment (https://goo.gl/Mh8lSy), as well as direct engagement via modeling and mapping courses (held in Costa Rica, Cambodia, Kenya, and South Africa). More importantly, we will integrate

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		national level planning structures and processes in programmatic work both as a means of improving the direct relevance of the research, and to maintain the trust and engagement of our partners. Our capacity development work is planned and executed with academic partners (NatCap Project) and international agencies including UNEP, and Swedbio. ESA scientists are engaged, and will continue to engage in phase 2 with national partners in the development of IPBES regional assessments, which provides capacity support though direct collaboration. We anticipate approximately 10% of the overall budget will be allocated to instructional design for continuing professional development and future research leaders, and for creating innovative learning materials that can be used across scales and regions. Because of the nature of the ESA approach however, upwards of 30% of the budget contribute to capacity strengthening activities.
Impact assessment	207,000	Impact assessments will be built into project activities as appropriate and in line with WLE's overall evaluation and impact assessment strategy (see Annex 3.5 on RBM). Bioversity with WLE and its partners has invested heavily in the development of an ecosystem service framework and now the MESH tool, which has been designed to support decision analysis and evaluation around the impact of large scale investments in land-use change. Success of the project and program would be evidenced through the use of the program and its results specifically in the interventions of the Volta Basin Authority's Strategic Action Program, and secondarily its use by partner countries in evaluating progress on the SDGs. Bioversity will lead an assessment of the utilization of the MESH model in large scale restoration investments in Burkina Faso, Ghana and Ethiopia using a qualitative causal tracing methodology. Impact assessments will be budgeted through projects and by identifying impact assessment funding from established sources on specific issues that have public good value. The primary costs for impact assessments are data-related: designing and conducting sample surveys, analysis and write up. These are incorporated into the lines on travel, supplies and services. Finally, the nature of both ESA CoAs provides a mechanism for supporting WLE flagship and AFS CRP impact assessments. The indicators and models developed in CoA 5.1 will provide landscape analyses that can be used as baseline data, whereas the decision support work of CoA 5.2 will provide intervention-specific targets through which final

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		project outcomes can be assessed. ESA as a flagship will invest in shared data management structures to facilitate both monitoring and evaluation of progress towards SDG indicators with national partners. Time allocations for impact assessments is part of the broader assessment work, including results monitoring, reviews and reporting, and learning and oversight activities, with approximately 10% of the Flagship Leader's and 5% of each Project Leader's time allocated to these functions.
Intellectual asset management	266,800	Compliance with the CGIAR Principles on the Management of Intellectual Assets is task of each WLE partner Center and backstopped by the Lead Center Legal officer and Business Development Director. The cost is part of supplies and services. This process will be supported by the CRP management at CRP level.
Open access and data management	115,000	ESA supports full compliance with the CGIAR Open Access and Data Management Policy. Due to the integrative nature of the flagship, we will work directly with the WLE flagships and the AFS CRPs on specific information structures that support integrative and synthetic analysis, leveraging and elevating the commodity-specific research of the AFS. Centers and partners working with ESA will be required to make their data publicly available quickly, following collection and publications. The ESA will work with WLE's KMC on the WLE solutions portal that will provide an openly accessible space for WLE data. The Flagship will put in place mechanisms rewarding data that is made publicly available, and which contribute to integration and synthesis efforts. We will encourage researchers to budget resources to cover OA/OD, like open access fees for articles. The Flagship will negotiate database membership fees if appropriate and will contribute to data quality assurance as part of its support of performance-based management. ESA will disseminate its research through the WLE website, blog and solutions platform.
Communication	690,000	The resources required for Knowledge Management and Communication (KMC) are budgeted in each ESA project, funded by W1/2 or bilateral. ESA plans communications via different media (press, radio, TV, blogs, etc.), online training courses, using knowledge products such as training manuals, business models, investment and policy briefs, decision support systems, and academic books and papers. The Flagship will work closely with the program-level KMC group on strategic communications planning and implementation. Activities will also include engaging with stakeholders through participating in policy level

Key Activity	Estimate annual average cost (USD)	Please describe main key activities for the applicable categories below, as described in the guidance for full proposal
		discussions and fora, engaging in key events at the national, regional and global levels, and, in particular, in multi-stakeholder platforms across natural resource and sustainability initiatives such as IPBES, TEEB, CBD, and the Global Landscapes Forum amongst others. A key feature will be in developing an integrated solutions platform that has the potential to achieve impacts at scale in different contexts. It will be complemented by both on- and offline outreach efforts, such as social media campaigns and events. The activities will also involve WLE uptake/communication staff based in participating Centers.

2.3.1.1 Other

The indirect costs in this budget includes costs for support service units such as HR, finance, administration, etc. In case there is a sudden decrease of funding, indirect costs will remain at a higher rate as it will take time to make adjustments. The indirect cost rate is based on Financial Guidelines 5 of CGIAR cost allocation guidelines.

The highest risks for this Flagship are instability of funding and increase of costs due to changes in the external and internal environment. The program team under the leadership of the Lead Center will review the risks on a quarterly basis and ensure that budgetary adjustments are tracked due to these risks.

The budget presented includes bilateral agreements which are yet to be approved and signed. The assumption is that the bilateral sources mentioned in this budget will be approved without any variance. Partnerships are largely supported through bilateral funding, which reduces the systemic risk from fluctuations in windows funding.

Inflation is considered in the costs at 2.63%, which is based on the average IMF projections for the next 6 years. The major costs are incurred in USD and, therefore, the risk in foreign currency exposure is insignificant.

2.5.3 Flagship Uplift Budget

Outcome Description	Amount Needed	W1 + W2 (%)	W3 (%)	Bilateral (%)	Other (%)
Outcome 5.5 Expansion of the program of work with RTB in Peru focusing on landscapes with large altitudinal gradients (upstream/downstream) and PES programs.	10,182,400	50	0	50	0
Outcome 5.6 Expansion of the program of work with FISH and RAFS in Cambodia with a focus on food-water-energy nexus of flood pulse rice/fish systems.	10,182,400	50	0	50	0
Outcome 5.7 Expansion of the program of work with FTA and DCL in East, Central and Southern Africa, strengthening of new partnerships for harnessing best practices in participatory model building and big data management, and acceleration of curriculum development and other capacity strengthening activities.	10,182,400	50	0	50	0

CGIAR Research Program On Water, Land and Ecosystems

Sustainable solutions for people and societies

Full Proposal 2017-2022 (Annexes)

Updated July 31, 2016

LED BY:

IWMI International Water Management Institute

IN PARTNERSHIP WITH:

Bioversity International

CIAT

CIFOR

CIP

FAO

ICARDA

ICRISAT Science with a human face

IFPRI International Food Policy Research Institute

ILRI International Livestock Research Institute

World Agroforestry Centre

WorldFish

3.0 Annexes

3.1 Partnership Strategy

3.1.1. Introduction

WLE's theory of change recognizes the critical role partners play in achieving the program's vision of sustainable and equitable agricultural intensification. Partners are essential at all stages of the impact pathway: generating evidence (discovery), engaging multiple sectors to contribute to and influence decision making (proof of concept), and shifting mind-sets and behaviors related to agricultural development and the environment and bringing about wide-scale change (impact). WLE's current partnership strategy lays out some core principles and processes that WLE will continue to build upon in Phase 2.

WLE's theory of change also acknowledges the inherent complexity of working on agro-ecosystems at scale. This requires multiple linkages and feedback loops among different sectors and actors as well as between the social and biophysical sciences. WLE's research-for-development (R4D) approach also emphasizes the need to co-design research for development projects with partners and stakeholders along the impact pathway. Finally, WLE operates as an integrating CRP (ICRP) and as such maintains strong partnerships with AFS CRPs as well as other ICRPs.

WLE's Phase 2 partnership strategy aims to:

- Clarify the types of partners WLE works with along its impact pathways and their roles;
- Support flagships to use a common framework for fostering and nurturing partnerships; and
- Provide clarity on the ways in which WLE and its partners can collaborate to achieve outcomes.

3.1.2. Partnership types

The Independent Evaluation Assessment (IEA 2016) found WLE's comparative advantage within the CGIAR included a number of features. WLE has impressive data on ecosystem health and biophysical parameters from across the developing world. This strength, combined with its R4D partnerships, supports scaling up research conducted by other CRPs to the landscape and regional level by building new institutional arrangements to manage agro-ecosystems. WLE also bridges the agriculture and conservation divide by harnessing strong collaboration with environmental organizations.

WLE has identified the following major partnership types that allow it to accompany the whole process of innovation from discovery to proof of concept to scaling up (see *Table 3.1.1*). It has to be recognized that these are not discrete levels: often, partners involved in scaling up are also part of the proof of concept stage and provide important inputs into the design of research. This Annex highlights examples of strategic partnerships through the different modes identified from the ISPC.

Research partners: Research partnerships are in WLE's theory of change central to identifying and developing solutions and evidence. These include WLE's core partners (the 10 CGIAR centers) along with hundreds of international, regional and national research partners. For each flagship's area of research, the selected partners have a demonstrated capability in the relevant area of expertise, linkages to relevant networks, and the capacity to deliver the relevant outputs and outcomes. Examples include consortia to bring together global experience in trade-offs and decision analysis (such as King College London, Hubbard Decision Analysis, Wageningen University and Stanford University), modeling (UNESCO-IHE and WFI University of Nebraska) and soil-carbon research (INRA, CIRAD and IRD).

Table 3.1.1: Types of Research Partners across the Impact Pathway

	Discovery	Proof of concept	Scaling up
Stage of WLE TOC	Providing evidence/ solutions	Changing perspective	Achieving action and impact
Types of partners	**Research partners**: * Global and national research consortia on decision analysis, ecosystem-based approaches, sustainable intensification and variability * Joint research agendas with the AFS CRPs	**Public policy partners**: National decision makers, sub-working groups, regional bodies **Development partners**: INGOs, NGOs, IFIs and bilateral donors **Capacity development partners:** Universities, training centers, cap building networks **Research**: Site integration with AFS CRPs	**Private sector partners:** Companies, PPPs and small medium enterprises **Development partners**: Multi-stakeholder platforms, municipalities, investment zones, IFIs, Donors, large-scale initiatives **Public policy partners**: * Regional/cross sectorial institutions (VBA, MRC, etc.) * Global processes and initiatives: Ramsar, IPBES, EAT, UNCCD, SDSN

WLE has formed strategic alliances with the AFS CRPs (initially with Livestock, FTA, DCL, RICE) in CGIAR target countries in sub-Saharan Africa and Asia. These partnerships will work both at the discovery and proof of concept stages to test the sustainability of out-scaling various crop and system interventions. WLE will mainly partner in site integration through its ESA Flagship.

Public policy partners: WLE works with influential public policy partners at different scales and levels to change perspectives and provide convening spaces to improve decision making. At the national level, WLE works with governments and policy think tanks to improve science policy dialogue. For example, in India, the IWMI-TATA partnership has been able to influence a number of policies related to groundwater. In Lao PDR, WLE has supported the nascent Policy Think Tank to improve how evidence is used in decision making. In Ethiopia, WLE and IWMI coordinate a policy sub-sector working group on sustainable land management.

At the regional and global level, WLE uses the IPGs it generates to engage with regional advisory bodies to influence large-scale investments and trans-boundary decisions, including the Nile Basin Initiative (NBI), the Volta Basin Authority (VBA), Southern African Development Community (SADC), the *Southern Agricultural Growth Corridor of Tanzania (SAGCOT*), the Mekong River Commission, and FAO's strategic program on Sustainable Food and Agriculture. Examples of IPGs that are being used by these groups include: Water Accounting+ with NBI, Groundwater mapping with SADC, and SAGCOT on landscape level planning.

Capacity development partners: WLE works with a number of capacity strengthening organizations (universities, training centers and professional networks) to improve how research is used for education. This includes professional development centers such as UNESCO-IHE, International Groundwater Resources Assessment Centre, the African Groundwater Network, regional networks (SUMERNET, WaterNet and the Association for Strengthening Agricultural Research in Eastern and Central Africa[(ASARECA]), and university partners, such as Cornell, Texas A&M, UNESCO-IHE,

University of Nebraska, and business schools. WLE also supports co-development of curricula in various universities in Laos, Myanmar, Vietnam, Ethiopia, and Ghana. WLE has also developed social learning processes through different types of platforms that bring stakeholders together such as its work on innovations platforms in Africa .

Development partners: Development partners are crucial to ensure that solutions and evidence piloted and adapted for widespread scaling out and then integrated into programs, policies or financing portfolios for impact. Some examples include:

- Local and international NGOs to bring solutions to scale: WLE works with INGOs and NGOs to adapt solutions and scale out results. NGOs include IDE on land and water productivity and RUAF for resource and waste recovery. WLE has developed unique partnerships on gender, including in India with the Foundation for Ecological Security, Sakhi Bahir, and SEWA; in Nepal with Helvetas and iDE; in Kenya with Groots; and in the Mekong with Oxfam.
- Professional organizations: Such organizations are effective routes to influence and get messages to the people that make decisions about how resources are managed. This includes the International Water Association (IWA) and International Commission on Irrigation and Drainage (ICID).
- International conservation agencies: WLE has developed unique partnerships with conservation agencies to link agriculture to improved natural resource management. Examples include WWF, IUCN, TNC, Conservation International and Natural Capital Initiative, and the Ecosystem Partnership (ESP).
- Donor and investors: WLE works with and advises key donors and financing institutions as partners to help them scale out research results. Examples include GIZ on reversing land degradation and IFAD on improving agriculture water management. We have also developed knowledge partnerships with international finance institutions for wide-spread scaling up of research such as Asian Development Bank (irrigation, water management), African Development Bank and World Bank (e.g. solar irrigation pumps, water productivity and sustainable land management), and the International Finance Corporation (hydropower).
- International multilateral UN organizations to ensure research is embedded into their programs. Examples include FAO, WFP, UNICEF and WHO.

Private sector: WLE recognizes the critical role of the private sector in unlocking private capital and accelerating market-driven ecosystems-based solutions to poverty. WLE has developed more than 30 specific partnerships with private sector entities. Some examples include:

- Public-private partnerships (PPPs) focused on economic zones such as SAGCOT, and PPPs with urban municipalities and waste water recovery companies.
- Large-scale enterprises concerned with managing their production and reputational risks for global and regional benefits (such as Nestle, SAB-Miller, Unilever and Danone).
- Small-medium entrepreneurs working particularly on resource recovery and reuse as well as with some water productivity technologies.
- Business platforms and investment groups such as the World Business Council for Sustainable Development, Economist Sustainability Summit, and Terra Global Investment Strategies.

3.1.3. Partnership modalities

WLE core strategic partners include the 11 CGIAR Centers and FAO. Six CGIAR centers are identified as Tier 1 partners (IWMI, Bioversity, CIAT, ICRAF, ICRISAT, and IFPRI), and five as Tier 2 partners (CIFOR, CIP, ICARDA, ILRI, WorldFish).

WLE enters into strategic partnerships at different levels of the impact pathway. These include selected AFS CRPs, international organizations, development partners and private sector entities with which more than one flagship is engaging (e.g. UNESCO-IHE, IFAD, World Bank and TNC). It is expected some of these strategic partners will be invited to be part of the WLE Steering Committee in order to ensure that the program meets their needs and is moving in the right direction.

WLE will build upon and expand the different partnership modalities that were developed in Phase 1 to ensure that partners are included in all aspects of the planning cycle:

- Co-leaderships of flagships and initiatives: WLE's flagships are jointly led by institutional partners, with the exception of the smaller RUL flagship, led only by IWMI.
- Co-funding and competitive calls: WLE will develop joint calls with AFS CRPs to engage NARS and other national partners.
- Refocusing of the Steering Committee: In Phase 2, the WLE Steering Committee will include broader representation across the spectrum of research to uptake partners to ensure that WLE's agenda is demand driven.
- Responding to partners' needs: WLE provides direct support to partners' needs. For instance, in Phase 1, WLE responded to the Rockefeller Foundation's request for support in developing the Global Resilience Challenge by applying WLE's innovative approach to competitive research design in the focal regions (funded by Rockefeller, SIDA, and USAID).
- Developing joint research agendas: WLE will be working with partners to ensure research is jointly developed or meeting needs of different actors along the results chain.
- Data sharing arrangements: WLE will continue to work with FAO to ensure that its datasets are included in FAO Aquastat for wider dissemination.

3.1.4. Strategic partnership activities

Engagement of senior management to sustain relationships: WLE program staff have extensive experience in engagement processes at all levels. A particular responsibility of the newly hired Program Director will be for coordination and engagement across CRPs and with key institutions.

AFS site integration: As mentioned above, WLE and AFS CRPs are establishing strategic partnerships to co-develop integrated demand-driven research for development to bring sustainable intensification to scale. This will leverage important R4D partnerships that WLE and AFS CRPs have at the national level.

Consultations with partners: In Phase 1 and continuing in Phase 2, each flagship (or what was at the time called *strategic research programs*) held consultations to develop collaborative research agendas. In 2013 and 2014, WLE held regional consultations in preparation for its focal region programs. WLE has also actively engaged in the GCARD consultations. Through IWMI, WLE is leading the CGIAR target country integration process in Ghana and Nepal (co-lead with CIMMYT) and has been actively participating in consultations in Bangladesh, Burkina Faso, Ethiopia, India, Nicaragua, Nigeria, Tanzania, Uganda and Vietnam.

Aligning and engaging with regional organizations, IFIs and development banks. As mentioned above, WLE has entered into strategic partnerships with advisory and inter-governmental bodies (SADC, VBA, NBI, MRC) and IFIs (IFAD, Africa Development Bank, Asia Development Bank). During Phase 1, WLE invested substantial effort in engaging and linking to regional processes, organizations and financings institutions. The regional consultations allowed our focal areas to align with regional policies and priorities (e.g., ECOWAS, CAADP, ASARECA in sub-Saharan Africa).

Aligning to global initiatives and international processes. WLE has developed important global partnerships to guide investments in development. WLE researchers have provided technical and

scientific advice to global processes such as the SDGs (through GEMI and SDSN), Ramsar Convention on Wetlands, IPBES and TEEB. In addition, WLE has partnered in global initiatives such as Ecosystem Systems Services Partnership (ESP), Global Landscape Forum and EAT Forum.

3.1.5. Sustaining partnerships

WLE will work to improve how it communicates and sustains partnerships in a number of ways:

1. Carrying out periodic evaluation of partnerships to understand partners' interest, needs and expectations.
2. Regular review meetings at global or regional levels to review partnerships and assess progress along impact pathways as well as communicate WLE's progress.
3. Developing a toolbox for projects and flagships to continually assess and refine partnerships and stakeholder engagement as WLE's theory of change evolves. This includes stakeholder analysis, evaluative tools and 360-degree feedback.
4. Ongoing dialogue and engagement strategies in most of the flagships include engaging ambassadors (individuals and organizations) and being directly involved in national and regional dialogues.

3.1.6. Capacity to partner

WLE has developed some initial capacities to partner. WLE built upon core partners' (particularly CPWF's) existing networks and networking skills and used these to establish a strong presence in its four core regions. In Phase 2, WLE will continue to invest in strong national and regional coordinators who can help to develop strong partnerships. WLE's flagship managers and operations team all have experience and skills in engaging and nurturing partnerships. WLE has learned to partner with tertiary institutions under Phase 1 and will focus further on capacity development partners in Phase 2 (see section above). WLE's IDOs requires significant capacity in strengthening research users' and partners' capacity for using WLE's research results in decision making. Examples of WLE's capacity-oriented partnerships include the RRR flagship partnership with UNU. In addition, the ESA flagship partners with Hubbard Decision Research, USA, the University of London, ZEF, and the African Technology Policy Studies Network to strengthen the capacity of decision makers to use decision-analysis tools.

3.1.7. Partnership resourcing

Given the funding constraints in Phase 2, WLE will initially incubate ideas with W1/W2 funding and then develop specific activity ideas with the partners using W3/Bi-lateral funding. For instance, the ESA flagship will undertake joint funding of commissioned activities with the AFS CRPs. Overall, WLE will continue to include at least 30% funding towards partnerships outside the CGIAR.

Annex 3.1.1 Partnership tables

WLE Program level

No. 1 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Program level Impact pathway: Global Level Processes**	
Convener of the Partnership and their role	UN Sustainable Development Solutions Network (SDSN) - Thematic Network on Data for Sustainable Development role is to bring together experiences in developing, implementing and monitoring the SDGs
Specific focus and objective	Improved use of data to accelerate learning towards achieving sustainable development goals
Science agenda	Big Data and Decision Analytics
Geographic focus/location	Global
Role of the CRP FPs: RDL, LWS, RUL, VCR ESA	Develop guidelines for targeting data collection efforts for improving stakeholder restoration decisions. In addition, WLE flagships assist governments to monitor implementation of the SDGs as well as provide new insights into unintended impacts and synergies across the SDGs to ensure an integrated perspective.
Key CGIAR partners and their roles	ICRAF: knowledge on decision analytic approaches and restoration options CIAT: Bioversity, DCL, IFPRI – knowledge on restoration decision processes IWMI: Research partner of UN-Water. Feeding latest data and data summaries into UN discussions and publications; backstopping of methodological work and decisions.

Key 'external' partners and their roles	SDSN: major global convening and advocacy role Queen Mary London University: decision sciences; capacity development Hubbard Decision Research: decision science and measurement; capacity development
Contribution to impact pathway and theory of change	Data collection efforts need to be aligned with areas that have high value for development decision if we are to provide incentives for decision-makers to act. This initiative will develop and disseminate guidelines on how to identify and analyze development decisions to identify data requirements, and develop capacity in the use of these methods. RDL will focus on restoration decisions.

No. 2 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Program level Impact pathway: Support to information decision-making**	
Convener of the Partnership and their role	**Global Landscapes Forum (GLF), Convener – CIFOR**
Specific focus and objective	The GLF is the leading science-based, cross-sectoral platform enabling countries, regional governments, civil society and private sector leaders to achieve climate and development goals based on sustainable landscapes. The specific objectives of this partnership are: • to advance work on large scale land restoration initiatives at global and regional levels. • to improve linkages to private and public financing of large scale land restoration efforts and foster dialogue around innovative financial instruments capable of connecting global funds with smallholders on the ground • to be a decision-forcing event facilitating communication between research and policy, in areas relevant to global conventions and initiatives
Science agenda	Research on landscape solutions, and in support of countries to track progress towards and realize the newly established Sustainable Development Goals and Paris Climate Agreement
Geographic focus/location	Global and region

Role of the CRP FPs: RDL/ESA/LWS	WLE (RDL and KMC) has a played a coordinating in GLF since 2014. WLE has been on the scientific committee and assisted in organizing the knowledge share fairs. In Phase 2 discussions are underway for WLE to be a core strategic partner in GLF contributing networks, science and dialogue experience.
Key CGIAR partners and their roles	CIAT: Contributing evidence based science on investment opportunities, monitoring landscapes, water funds, landscape level planning, soil health and Climate Change, convening national government partners in Latin America and Africa. IWMI: agriculture water management solutions at landscape level, particularly related to sustainable land management IFPRI: evidence based on land tenure, rights and gender ICRAF: Decision-analysis for landscape level planning and soil health system. Bioversity: methodologies and tools for landscape and ecosystem based management
Key 'external' partners and their roles	UNEP: convening role to bring global actors together. World Bank: convening and funding role WRI Initiative 20by20: analysis of regional restoration investment opportunities, convening partners in Latin America, facilitating and generating financing commitments from impact investors
Contribution to impact pathway and theory of change	Contributes to WLE's pathway to influence global level processes related to sustainability, large scale land restoration efforts and climate change that is anticipated to support national agenda setting and provide an enabling policy environment for achievement of SDGs, and WLE and CGIAR SRF goals. Provides convening space to present WLE research in large global forum that WLE could not convene on its own.

Flagship - Restoring Degraded Landscapes (RDL)

No. 3 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Restoring Degraded Landscapes (RDL)** **Impact pathway: Providing supporting evidence and capacity strengthening to enable investments in soil restoration, targeting climate finance**	
Convener of the Partnership and their role	4 0/00 Soil Carbon Restoration for Food Security and Climate Change Conveners: CGIAR and the French Research Institutes CIRAD, INRA and IRD
Specific focus and objective	Building soil carbon stocks to restore degraded soils with food security, ecosystem and climate mitigation benefits
Science agenda	Potential to increase soil carbon stocks on tropical soils and landscapes; valuing ecosystem services benefits of soil carbon; how soil carbon is or is not related to livelihoods; what constrains farmers from investing in maintaining or increasing carbon stocks; how to measure and monitor soil carbon stocks; potential of soil carbon to mitigate climate change
Geographic focus/location	Kenya, Tanzania, Ethiopia, Colombia, Peru
Role of the CRP FP: RDL	RDL is coordinating scientific research on tropical soils of the CGIAR to contribute to the 4 0/00 and development and implementation of the CGIAR Green Climate Fund initiative with CCAFS
Key CGIAR partners and their roles	• CIAT: Empirical data and predictive models on the potential for soil carbon sequestration under differing management in tropical soils and landscapes; evaluating the benefits of soil ecosystem services; evaluating challenges (economic, political) for investment in soil carbon • ICRAF: Spatial models that predict soil carbon and health under alternative land use management; MIR and UAV based soil carbon measurement and monitoring • CIP: UAV based landscape and soil carbon measurement and monitoring

	• CCAFS FP3: Political and institutional readiness to access and deploy climate financing in target countries; linkage to NDCs (Nationally Determined Contributions) and the global climate mitigation agenda
Key 'external' partners and their roles	• INRA/RD/CIRAD: through its ECO & SOLS program is spearheading the research initiative of the 4 0/00 • WUR – University • ISRIC: definition, measurement and mapping of soil organic carbon stocks; deriving regional stocks from point data and covariates • Alterra: Evaluation of landscape nutrient balances and availability to support biomass production and soil organic matter build up for soil health • GIZ Soil Rehabilitation for Food Security Program: implementing soil rehabilitation measures and linkage to policy processes and initiatives in the 5 soil rehabilitation countries • Governments of Ghana, Senegal, Tanzania, Uganda, Vietnam, Nepal, Colombia: Implementation of GCF projects on soil carbon building in their countries
Contribution to impact pathway and theory of change	With these partners we work along the four pathways defined by WLE's ToC: 1) with CCAFS in dialogue with policy makers and implementers to support development of readiness to implement climate financing; 2) developing evidence of opportunities and benefits in soil carbon building to motivate investment aligned with national priorities and policies; 3) co-develop analysis, models, tools and engage in dialogue with multi sector stakeholders to increase awareness of the potential of restoration initiatives; and 4) engage with partners to develop capacity to support changes.

No. 4 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Restoring Degraded Landscapes (RDL)** **Impact pathway: Providing supporting evidence and capacity strengthening to enable investment in land restoration, targeting investment by local stakeholders and international agencies through public/private partnership**	
Convener of the Partnership and their role	**Convener is the TNC and Upper Tana Water Fund** TNC's role is to provide experience in upstream water and soil conservation measures, resulting in improved water quality and supply, develop the business case and leverage experiences from Latin America in Water Funds.
Specific focus and objective	Reduce sedimentation in the Tana River through sustainable land management in the upper watershed with benefit to local rural population and downstream water users
Science agenda	Targeting of interventions for optimal return, articulating trade-offs and synergies between agricultural livelihoods and conservation within various trajectories of change, cost-effective monitoring and assessment of ecosystem services, utilizing crop suitability and climate change scenarios for planning of interventions
Geographic focus/location	Tana Basin, Nairobi, Kenya
Role of the CRP FP: RDL	*Ex-ante* assessment of water quality benefits of various intervention strategies, incorporation of agricultural livelihoods into the conservation agenda, creating closer linkages between Water Fund partners and farmer organizations, enhancing capacity for monitoring and assessment of ecosystem services
Key CGIAR partners and their roles	CIAT: member of the Water Fund Steering Committee, providing research evidence and capacity strengthening in support of the Tana Water Fund business case IFPRI: Gender studies, role of women in conservation and ecosystem services

Key 'external' partners and their roles	Water Fund Partners (Kenya's primary power utility (KenGen), Nairobi City Water and Sewerage Company, Tana and Athi Rivers Development Authority, Kenya's Water Resources Management Agency and United Nations agencies in Nairobi, the water technology company Pentair, East African Breweries, Coca-Cola and Frigoken Horticulture): These partners contribute funds targeting upstream restoration; in addition Frigoken and Green Belt Movement engage directly with farmers to implement water fund activities and Kenya Water Resource Management Agency implements the water quality monitoring scheme. Global Environment Facility (GEF) 8 million USD grant to implement Water Fund activities. The Nature Conservancy (TNC) – developing the business case for water funds and scaling to new potential sites in Africa Natural Capital Project of Stanford University: InVEST and RIOS modeling and capacity strengthening for ecosystem services evaluation
Contribution to impact pathway and theory of change	In this partnership we work along the four pathways defined by WLE's ToC: 1) in dialogue with policy makers and implementers to ensure appropriate programs and or legal framework are in place to create an enabling environment for restoration, and safeguard the rights of land owners; 2) develop evidence of risk, return and societal benefits to restoration to motivate investment aligned with national priorities and policies; 3) co-develop analysis, models, tools and engage in dialogue w/ multi sector stakeholders to increase awareness of the potential of restoration initiatives; and 4) engage with partners to develop capacity to support changes. In the Tana Water Fund, we also work directly with NGOs (Green Belt Movement) and a private company (Frigoken) to design and target interventions for adoption by farmers.

Flagship - Land and Water Solutions for Sustainable Intensification (LWS)

No. 5 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Land and Water Solutions for Sustainable Intensification (LWS)** **Impact pathway:** Pathway on engagement with (national) policy makers and national strategies	
Convener of the Partnership and their role	Convener: Agricultural Transformation Agency Ethiopia (ATA) http://www.ata.gov.et/ ATA's role is to oversee implementation of government policy and coordinate development partner's efforts.
Specific focus and objective	**ATA is a strategy and delivery-oriented government agency created to help accelerate the growth and transformation of Ethiopia's agriculture sector according to agreed national growth and transformation agenda. The Agency's mandate is focused solely on improving the livelihoods of smallholder farmers across the country.**
Science agenda	Providing decision support, and knowledge products on sustainable intensification practices in agricultural land and water management (ALWM) technologies that result in scalable higher agro-ecological productivity, resilience and greater benefits (food, nutrition, income and ecological benefits) at the landscape scale to support investments, policies and incentives
Geographic focus/location	Ethiopia
Role of the CRP FP: LWS and RDL	Support evidence based knowledge for input into policy design and investments into agricultural transformation policy
Key CGIAR partners and their roles	IWMI and ICRISAT provide advice and decision support in ALWM technology out-scaling through solutions which consider at technical, institutional and social innovations needed for scaling. IWMI serves on the Technical Committee of the National Smallholder Irrigation & Drainage project provided by ATA Project initiated by Ministry of Agriculture and Natural resources (MoANR), overseen by Steering Committee with MoANR / Ministry of Water, irrigation and Energy (MoWIE) / ATA / Ministry of Livestock and Fish (MoLF) with the purpose to guide efforts and investments in next 5-10 years, including sizable budgets

	allocated as part of AGP II and other major programs. IFRPI also lead a Research for Ethiopia's Agricultural Policy (REAP) to support ATA in obedience based policy around agricultural development
Key 'external' partners and their roles	Several NGOs and CBOs work with ATA in implementation at sub national level IFIs (i.e. Bill & Melinda Gates Foundation, provide funding for a majority of ATA and additional support is provided by GIZ and USAID among others for implementation of activities) support activities of the Ethiopian ministries, especially Ministry of Agriculture and Natural Resource Management
Contribution to impact pathway and theory of change	ATA is the main provider of policy advice for the Ethiopian Transformation agenda with Ministry of Agriculture and Natural Resource Management advising on all policy and implementations in agricultural development
No. 6 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Land and Water Solutions for Sustainable Intensification (LWS)** **Impact pathway:** Impact pathway 2 to influence large scale investments in more effective irrigation modernization by IFIs and other development investors large scale investments in more effective irrigation modernization by IFIs and other development investors	
Convener of the Partnership and their role	Convener: Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (CILSS) and World Bank Sahel Irrigation Initiative (SII) http://www.cilss.bf/spip.php?rubrique69
Specific focus and objective	CILSS is a regional Sahel initiative to support food security and the fight against the effects of drought and desertification for a new ecological balance in the Sahel. The SII component of the CILSS Task Force is to help develop: a) a strategic and bold vision on how to achieve the Dakar declaration objectives, b) a global action plan, including technical, institutional, financial and investment components, for the achievement of the Dakar Declaration, c) regional project level actions to support the implementation of the global action plan in the six countries covered by the SII, and d) review and comment on thematic studies commissioned to provide background information on pertinent dimensions of irrigation in the Sahel.
Science agenda	• Provide opportunities for, and remove constraints to, the use of new business models (including public–private partnership investments) and market forces (better connection with regional or export market opportunities) to improve irrigation service delivery and cost-sharing in LSIS (Large Scale Irrigation Systems). These interventions are intended to increase social and economic benefits, and minimize undesirable environmental impacts

	• Present solutions to address ecosystem service objectives into irrigation management goals
Geographic focus/location	West Africa member states of SILS (Burkina Faso, Chad, Mali, Mauritania, Niger and Senegal)
Role of the CRP (FP: LWS)	IWMI – through LWS serves as a technical partner
Key CGIAR partners and their roles	IWMI: provides decision support and knowledge to improving design of LSIS design for improved sustainability and benefit distribution IFPRI: provides new models of PPP on LSIS investments and management
Key 'external' partners and their roles	CILLS and constituent members (representatives of government of member states , and Ministries managing agriculture and Irrigation development)
Contribution to impact pathway and theory of change	(i) Joint research with public and private sector actors on business and partnership models for irrigation revitalization and organizational reform; (ii) on-going dialogue and support in the SII Task Force with policy-makers linking regional and national strategies to change perceptions about the potential for improved irrigation and drainage performance and to facilitate policy revisions creating effective incentive structures and other enabling environments.

Flagship - Rural Urban Linkages

No. 7 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Rural Urban Linkages (RUL)** **Impact pathway:** Focused on RUL impact pathways "Business Schools & Business Sector".	
Convener of the Partnership and their role	IWMI facilitating the PPP set-up Private public partnership on closed loop processes in Ghana
Specific focus and objective	To test the implementation potential and replicability of innovative RRR business models via private public partnerships
Science agenda	To learn from these pilots for improving the business models, investment climate, institutional match making, and Theory of change for further replication
Geographic focus/location	Ghana
Role of the CRP FP: RUL	The RUL Flagship is coordinating via IWMI the piloting of RRR business models via private-public partnerships of Jekora Ventures Limited and different municipalities and districts (Tema).
Key CGIAR partners and their roles	IWMI: global coordination, business model design and implementation for (1) fecal sludge and organic solid waste to compost pellets, (2) organic solid waste to fuel briquettes; and capacity building, impact assessments, replication plans for other countries and regions ICRAF: Technical back stopping for briquette business
Key 'external' partners and their roles	• Private companies (Jekora Ventures Ltd.): Operation, maintenance and marketing of waste-based products (compost and fuel briquettes). • Municipalities (Tema Metropolitan assembly): Facilitation of and supervision over the activities of private companies. • National universities (Valley View University, University of Ghana): Research and capacity building. • International NGO (RUAF Foundation): Stakeholder (community / farmers) engagement, Social responsibility plans

	• National research/development organizations; Training Research and Networking for Development (TREND): Research, public sector stakeholder engagement, certification of waste based products with public authorities. • * Advisory board: Representatives from Environmental Protection Agency (EPA), Ministry of Food and Agriculture (MOFA), Ministry of Local Government & Rural Development (MLGRD), etc.: Their role is to support the implementation of the businesses and to allow adoption of research outputs.
Contribution to impact pathway and theory of change	This partnership allows demonstrating the viability of proposed business models. Lessons are generated from implementation and help fine-tune business models, understanding capacity needs and institutional linkages. In particular, lessons on private sector involvement (opportunities and challenges) are evaluated for improving the theory of change.
No. 8 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Rural Urban Linkages** **Impact pathway:** the partnership contributes to all three pathways identified by the flagship.	
Convener of the Partnership and their role	Food-for-cities-program (FAO and RUAF Foundation), FAOs role is to support policy dialogue and global networking. RUAF Foundation is to facilitate multi-stakeholder processes and platforms
Specific focus and objective	To foster the development of resilient and sustainable food systems within urban centers, peri-urban and rural areas surrounding cities, by strengthening rural-urban linkages.
Science agenda	To analyze, verify and operationalize the theoretical concept of City Region Food Systems (CRFS) as a basis for further planning and informed decision making. CRFS are assessed and characterized to identify gaps and bottlenecks, prioritize investments, and design sustainable food policies and strategies, thanks to multi-stakeholders participatory dialogues.
Geographic focus/location	FAO, through its Food for the Cities Program, has launched projects in the city regions of Colombo (Sri Lanka), Lusaka (Zambia), Kitwe (Zambia), Medellín (Colombia) and Dakar (Senegal). The RUAF Foundation, through its City Food Tools Project, has launched projects in the city regions of Utrecht (The Netherlands), Quito (Ecuador) and Toronto (Canada).
Role of the CRP FP: RUL	WLE via its RUL flagship is supporting the research framework, indicator selection and methodological approach, especially in data scarce environments. RUL is also leading one city pilot (Colombo) under CoA 3.1.

Key CGIAR partners and their roles	IWMI: research support, case study analysis, comparing lessons across cases) and FAO (global coordination, back stopping
Key 'external' partners and their roles	Local universities, NGOs and municipalities in 8 locations for data generation and presentation, RUAF Foundation as facilitator of multi-stakeholder processes and platforms (MSP) and to compare cities, FAO in charge of policy dialogue and global networking.
Contribution to impact pathway and theory of change	The multi-national and multi-scale partnership allows WLE to compare cases along the development trajectory as well as insights in regionally different MSP strategies for policy development which will allow learning for the theory of change.

Flagship - Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)

No. 9 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)** **Impact pathway: CoA2 impact pathway focused on influencing global mechanisms to influence environmental outcomes.**	
Convener of the Partnership and their role	Convener: Australian National University, their role is to coordinate the Food, Energy, Environment and Water (FE2W) Network, includes about 30 additional partners from academia, practitioners, development banks and the private sector. It furthermore includes a series of national and basin partners in the regions WLE works
Specific focus and objective	The FE2W Network works with decision-makers to improve the understanding of systemic risks and how to manage shocks across these systems. The approach is founded on collaboration and an emphasis on poverty reduction, sustainable livelihoods, and the need to maintain critical ecosystem services.
Science agenda	Research for enhanced decision processes along the water-energy-food nexus
Geographic focus/location	6 focal regions (Ganges/Brahmaputra, Mekong, Volta, Nile and outside the scope of WLE: Colorado and Murray-Darling)
Role of the CRP FP: VCR	WLE via its members is chairing the network through the VCR Flagship with contributions from the ESA flagship; VCR and ESA are jointly developing tools with the FE2W network, and are jointly analyzing various decision processes along the water-energy-food nexus in the focal regions and elsewhere.
Key CGIAR partners and their roles	Key CGIAR partners include IFPRI and IWMI. IFPRI is chairing the network and raising funds for WLE under FE2W using FE2W tools and processes, is participating in conceptual development, case study analysis and publications. WLE (hosted by IWMI) is participating in tool development, analysis, and publications. Depending on the case studies, LWS might also be added to the network.

Key 'external' partners and their roles	Australian National University in Canberra is hosting the Secretariat of the network and is the initiator of the network. The network includes about 30 additional partners from academia, practitioners, development banks and the private sector. It furthermore includes a series of national and basin partners in the 6 focal regions.
Contribution to impact pathway and theory of change	The network is both a research and an uptake partner and contributes to tool development, case study analysis and has an important role in tradeoff dialogues, which are being held under CoA2.
No. 10 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)** **Impact pathway: CoA1 - Engagement with global practitioners and international organizations to provide solutions on disaster management and minimizing impacts from variability.**	
Convener of the Partnership and their role	Convener is UNISDRR (with support from IWMI) and the role is to provide disaster risk community of practitioners and international humanitarian organizations with disaster management information and data to be used in real time for disaster affected areas
Specific focus and objective	To foster the development of resilient and sustainable communities and agro-food systems in major river basins and to test the implementation of potential and replicability of innovative WLE disaster management solutions
Science agenda	To analyze, verify and operationalize disaster management information and data; to provide targeted data and information tools in real time for disaster affected areas.
Geographic focus/location	Global, but collaborate in WLE areas as required. Recent engagements included Nigeria, India, Sri Lanka
Role of the CRP FP: VCR	WLE via its VCR flagship is either a member / nodal point of some of these global / regional organizations (Sentinel Asia, UNOSA, GEO), contributes to its framework conventions / processes (UNISDRR), provides inputs for humanitarian / relief operations (National Disaster management ministries, WFP, etc.), or co-develops products and tools (with WMO, GWP, etc.).

Key CGIAR partners and their roles	IWMI: research support, case study analysis, comparing lessons across cases
Key 'external' partners and their roles	UN International Strategy for Disaster Reduction (UNISDRR): outreach to a large network of Disaster-related organizations globally UN Office for Outer Space Affairs (UNOOSA): dissemination of WLE products and tools internationally Sentinel-Asia: provision of targeted remote-sensing data and products in real time for WLE – for disaster monitoring and support of relief operations WMO and GWP: co-development of crop and drought monitoring tools and stakeholder engagement
Contribution to impact pathway and theory of change	This multi-national and multi-scale partnership allows demonstrating viability and replicability of WLE outputs in various geographical and socio-economic contexts. Lessons are learned from using the data and tools that help fine-tune these tools, understand capacity gaps and institutional linkages.

Flagship - Enhancing Sustainability across Agricultural Systems (ESA)

No. 11 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Program level Impact pathway:**	
Convener of the Partnership and their role	**UNESCO-IHE and WLE**
Specific focus and objective	The focus of this partnership is on capacity building and the development of tools for decision support. Specific objectives include: • Support for curriculum development for students and mid-career professionals in key tops related to water management and ecosystem services

	• Development and analysis of advanced datasets and decision-support tools for water and land management and the assessment of trade-offs and the implications of development decisions on water resources and ecosystem services.
Science agenda	Research on development of new and advanced data streams and their assimilation into decision-support tools for land and water resources planning, research on governance, gender and social equity
Geographic focus/location	Global and national
Role of the CRP FPs: ESA/LWS/RUL/VCR	Role of WLE is to provide evidence through on the ground case studies for use in the development of curricula. It also provides opportunities for UNESCO-IHE to collaborate in on the ground research at the local level in Africa and Asia, and to tailor the tools developed to user needs in these regions.
Key CGIAR partners and their roles	IWMI: provide business models, co-development of decision support tools, use case studies and other inputs into curricula development IFPRI: provide business models and inputs into curricula development
Key 'external' partners and their roles	UNESCO-IHE: support for the development of decision-support tools and modeling, provide PhD students to assist in data collection and analysis and to undertake field research
Contribution to impact pathway and theory of change	Contributes to decision-support systems for investors and policy makers, particularly regional advisory bodies working on water stocks, flows and fluxes. In addition, focuses on capacity development of curricula and learning materials which can be used by students and mid-career professionals.

No. 12 **CRP: CGIAR Research Program on Water, Land and Ecosystems** **Flagship: *Enhancing Sustainability across Agricultural Systems (ESA)*** **Impact pathway: Engaging with policy makers at national and regional level to improve use of decision analysis tools**	
Convener of the Partnership and their role	Convener of the partnership is Hubbard Decision Research Group and ESA. The role is to bring together state-of-the-art decision analysis tools and methods and to adapt them to WLE's thematic focus areas
Specific focus and objective	To access state-of-the-art decision analysis tools and methods and to adapt them to WLE's thematic focus areas
Science agenda	Collaborative analysis of development decisions, and refinement of methodologies.
Geographic focus/location	Global
Role of the CRP FP: ESA	Convene stakeholders and facilitate participatory decision analyses, apply methods that are jointly developed with partners.
Key CGIAR partners and their roles	ICRAF – support coordinating overall process and ensure decision analysis methods emerging from this partnership are applied on decisions pertinent to WLE, DCL, FTA and other CRPs. DCL – Provides research data and methodologies on dryland farming systems. Convenes and avails its partner networks of decision-makers and experts for participatory decision analysis processes

	FTA – Provides research data and methodologies on sustainable forest and agroforestry management practices and the specific measures of agricultural and environmental externalities of these measures. Convenes and avails its partner networks of decision-makers and experts for participatory decision analysis processes
Key 'external' partners and their roles	Hubbard Decision Research; Risk Information Management Research Group at Queen Mary University of London Their role is to provide new approaches to decision-analysis. The partners are world-leaders in decision analysis methods, and this collaboration harnesses this expertise for the benefit of WLE's target groups.
Contribution to impact pathway and theory of change	If research for development does not manage to influence the decisions of those with the power to affect lives and landscapes, it will struggle to have impact. By engaging directly with decision processes, through use of advanced Information Systems technologies and decision analysis techniques, this cluster will be instrumental in taking WLE science to where it can have impact. Through the use of decision analysis methods, which are adapted for use in agricultural development contexts in this partnership, researchers can emulate the situation of development decision-makers who need to make risky decisions on complex systems with insufficient data. The partnership thus helps to bridge the commonly observed gap between science and decisions, raising the chance that research findings will be considered in decisions and ultimately lead to impact.

3.2 Capacity Development Strategy

3.2.1. Role of capacity development (CapDev) in WLE's impact pathway

"You can bring all the money you want to a country, but without the right capacity you achieve nothing." 1

The water and land sectors are vital for long-term sustainable development, yet noted for their inadequate capacity to meet global challenges. The urgency of sustainably intensifying agriculture while enhancing other ecosystem services deepens the need for sustained, higher capacity from farm to landscape levels. WLE will contribute to meeting critical natural resource management (NRM) capacity needs identified during Phase 1 and through collaboration with its partners.

WLE capacity development goals:

1. Strengthen the capacity of partners to engage in NRM research, and to effectively use research results at multiple scales to solve key development challenges and deliver measurable development outcomes.
2. Contribute to individual and institutional capacity to innovate, adapt and maintain the capacity needed in response to internal and external contextual changes over time.

Lessons and best practices: A review of WLE's Phase 1 CapDev activities reveals lessons on effective investment in training at multiple scales: farmers and local change agents, such as National Agricultural Research and Extension Systems (NARES), to develop and use new technologies and practices; scientists in the developing world to apply new approaches, frameworks, and methods for discovery and analysis; and decision makers at national, regional and global scales to improve planning and investing that recognize the complexity of intensified, sustainable farming systems and associated ecosystem services. CapDev interventions at multiple levels are mutually reinforcing and can lead to higher, sustained capacity. In the second phase, WLE will target interventions along the impact pathways and work more closely with capacity development partners. WLE will put greater emphasis on monitoring and evaluation (M&E) of CapDev to strengthen learning as a dimension of its Theory of Change.

Capacity development to enable change and impact: WLE will integrate capacity development as an enabler into each stage of its impact pathways toward achieving the Intermediate Development Outcomes (IDOs) and System-level Outcomes (SLOs), and will approach CapDev as an entry point for effective engagement with each of its key uptake partners, as represented in *Figure 3.2.1*.

The main targets of WLE's CapDev activities are as follows:

- Enable **NARS, NGOs and CBOs** to collaborate in the generation of research results and piloting of solutions, as well as in the co-development of tools and materials for out-scaling solutions and influencing other target groups, particularly in the integrated sites.
- Enable **global stakeholders** in the co-development of science-based ideas and approaches that meet urgent global needs.

1 Executive Secretary of the African Ministers Council on Water, Bai Mass Tal, 6th World Water Forum in Marseille, 2012.

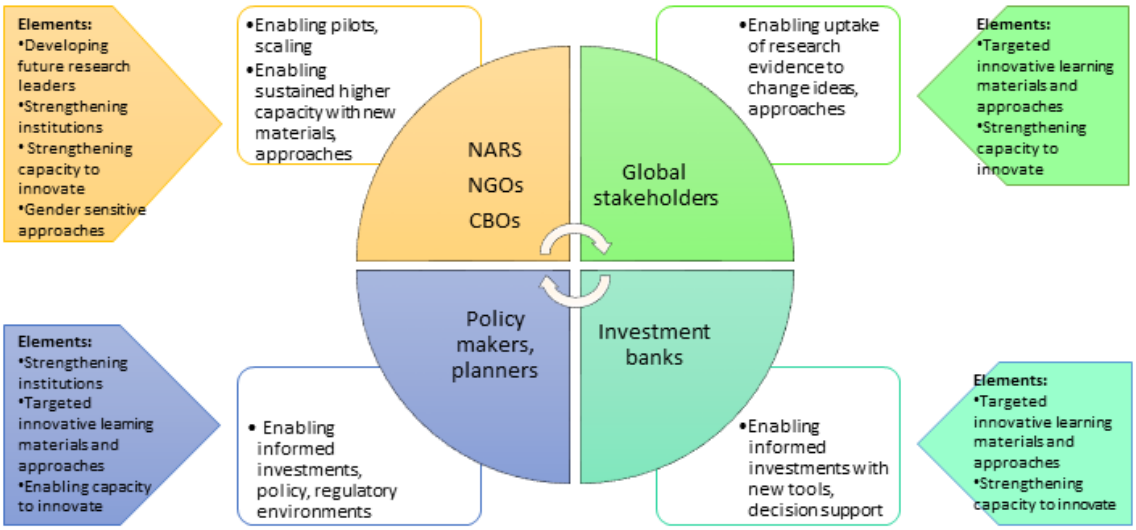
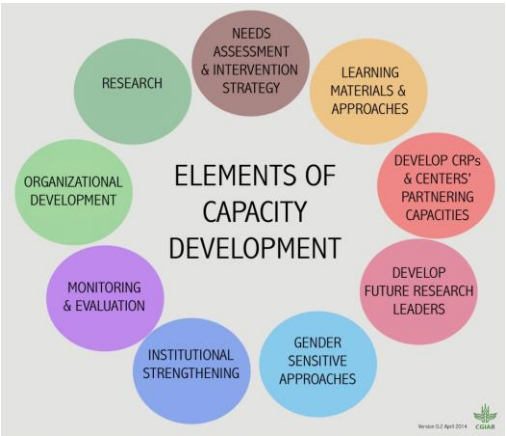


Figure 3.2.1. Capacity Development Approach to Strengthen the Strategic Role of Uptake Partners
Notes: NARS – National Agricultural Research Systems; NGO – Nongovernmental organization; CBO – Community-based Organization

- Support **investment banks and related financing institutions** to make evidence-based decisions and plans for future investments that directly or indirectly impact natural resource management at national, regional and global scales.
- Enable **policymakers, along with technical experts, regulatory bodies, and planning agencies**, at national, sub-national and regional levels to use decision-support tools and research results for planning and investment.

3.2.2. Strategic CapDev actions

WLE will emphasize four elements from the CGIAR CapDev Framework (listed in *Figure 3.2.2*) across the broader program: 1) integrating gender and gender-sensitive approaches into its CapDev interventions; 2) using innovative learning materials and approaches; 3) strengthening institutions; and 4) enabling the capacity to innovate. WLE also places medium emphasis on developing future research leaders, and ensuring M&E for learning and adapting. WLE understands the CapDev elements to be complementary and intends to combine elements within a non-linear process of accumulated learning to achieve higher capacity.



1. Capacity needs assessment and intervention strategy design
2. Design and delivery of innovative learning materials and approaches
3. Develop partnering capacities of CGIAR Research Programs (CRPs) and centers
4. Developing future research leaders through fellowships
5. Gender-sensitive approaches throughout capacity development
6. Institutional strengthening
7. Monitoring and evaluation (M&E) of capacity development
8. Organizational development
9. Research on capacity development
10. Capacity to innovate

Figure 3.2.2. CGIAR CapDev Framework Elements (numbered)

Flagship targets, activities and partners: WLE's strategy for CapDev will be operationalized through the flagships, as highlighted in *Figure 3.2.3*. The approach to each element, and a few illustrative examples of actions and partners are outlined below.

Flagships and cross-cutting	CapDev element									
	1	2	3	4	5	6	7	8	9	10
ESA										
RDL										
LWS										
RUL										
VCR										
GID										

Medium High

Figure 3.2.3. Flagship CapDev Elements

Capacity needs assessment and intervention strategy: WLE considers needs assessments to be the basis for effective targeting of CapDev actions in its Theory of Change; to change capacity, the CRP must know what capacity exists, what will be needed, and how to ensure higher capacity where needed. WLE will work with capacity development partners on needs assessments in integration sites (e.g. Nigeria) and through its flagships (e.g. ESA), particularly where existing capacity is very low, and for issues with few or no best practices in capacity development and instructional design.

Innovative learning materials and approaches: WLE aims to introduce new methods, tools, and approaches to decision makers to meet development challenges at landscape and global levels. CapDev investments can reach more audiences using innovative materials and approaches, such as webinars, Massive Open Online Courses (MOOCs), and web-based platforms. For example, through RUL, WLE will support free online curriculum on resource recovery and reuse business options, and adapt courses to be relevant to national partners, development banks, municipal staff and entrepreneurs. Through VCR, WLE will also train river basin organizations, and water and agricultural ministries to analyze water variability, and manage and plan for related risks on decision-support tools and governance mechanisms.

Future research leaders: WLE will continue to support the development of young scientists that will become future research leaders, decision makers in national and global institutions, and the private sector. WLE will provide fellowships, training and mentoring to young men and women scientists and practitioners on integrative research approaches that utilize cutting-edge technologies, e.g. large-scale assessment of inherent spatial and temporal heterogeneity in soil health (through RDL), and to integrate new methods, tools and products into tertiary and vocational curricula in CGIAR integrated site countries.

Gender-sensitive approaches: WLE will ensure CapDev activities consistently address gender-related dynamics and issues. WLE understands that increasing women's as well as men's capacities will contribute to strengthening institutions for improved equity through projects and programs. A central element of the LWS and RDL flagships is research on how capacities and capabilities are gendered, and how they need to build up for women to be able to have access and effectively use agricultural water and land management (AWLM) solutions, or are able to invest in reversing land degradation. This will lead to producing innovative learning materials and adapted instructional

design for all WLE target groups. At the same time, WLE will continue to invest in and create opportunities for women to be research leaders and champions in research and scaling of results.

Institutional strengthening: WLE recognizes that some institutional constraints are outside the scope of CRPs, but it also sees stronger institutional capacity to use decision-support tools and research evidence as critical to planning and implementation. In Phase 2, for example, WLE's RDL flagship will train scientists and practitioners from the agri-food system (AFS) CRPs and partner organizations in new scientific methods and frameworks to assess and adapt soil restoration practices to different contexts. VCR will further develop capacity of river basin organizations to integrate groundwater into conjunctive water management and planning.

Capacity to innovate: Based on its experience and lessons, WLE flagships identified capacity to innovate as a priority CapDev element. WLE's emphasis is on supporting innovation in research approaches, in the use of new methods and tools for decision making, and in facilitating collaborative learning and knowledge sharing. This is also integral to scaling solutions, which will require innovative adaptation to new contexts and conditions. In action, this means facilitating collaborative priority setting, co-development of scalable learning materials, tools and approaches, and generating outputs suitable for scaling, such as through multi-stakeholder dialogues. As an example, at the AFS level, WLE will provide technical support, tools and training related to piloting and upscaling of flood- and drought-tolerant crop varieties.

3.2.3. Capacity development partners

WLE recognizes the challenges in ensuring effective capacity development planning, implementation and evaluation. WLE will strengthen its partnerships for CapDev actions in the next phase and has identified potential partners for this. Examples include: universities and training centers (e.g. Bahir Dar University, University of Nairobi, Sokoine University of Agriculture, UNESCO-IHE Institute for Water Education, Columbia University, Queen Mary University); web-based courses and curricula (e.g. Cambridge Judge Business School, UK); regional and international organizations (e.g. Resource Centers on Urban Agriculture and Food Security [RUAF] Foundation, International Union for Conservation of Nature [IUCN], International Groundwater Resources Assessment Centre [IGRAC]); and AFS CRPs for CapDev on scaling. In an uplift scenario, WLE will raise funds and target resources to strengthen these partnerships, and increase needs assessments and evaluations. In addition, WLE's active participation in the CGIAR Community of Practice on Capacity Development, and inter-CRP collaboration with AFS CRPs (particularly Forests, Trees and Agroforestry [FTA] and Dryland Cereals [DCL]) will strengthen the capability to deliver best practices and methods in instructional design and learning.

Table 3.2.1. WLE CapDev Sub-IDOs and Indicators

CapDev Sub-IDO	High-level Indicators	Outcome-level Indicators
Sub IDO 3. Increased capacity for innovation in partner research organizations	Frequency of CRP engagement in learning process	○ Number of early career scientists participating in CRP research ○ Number of scientific publications by fellows, students, and trainees accepted ○ Number of successful research proposals involving fellows and postdoctoral fellows

CapDev Sub-IDO	High-level Indicators	Outcome-level Indicators
Sub IDO 4. Increased capacity for innovation for partner development organizations, and poor and vulnerable communities	Adaptation, adoption and spread of innovations linked to CRPs' participatory research results	○ Number of people trained ○ Number of policy- and/or technical-oriented knowledge events targeting strategic partners/stakeholders ○ Number of multi-stakeholder platforms facilitated ○ Number of partner organizations who use materials and approaches
Crosscutting sub-IDO: Improved capacity of women and young people to participate in decision making	Increase in the percentage of women and youth that participate in dialogues and engagement processes that influence decisions in NRM	○ Proportion of funding for young women researchers in developing countries ○ Number of CapDev activities in gender approaches initiated ○ Funding made available for design/review of gender-sensitive approaches in CRPs, and partner programs, projects, and policies
Enhanced capacity to deal with climatic risks and extremes	Increase in national and regional institutions with policies, action plans and budgeted programs for responding to climate extremes	○ Number of policy decisions taken (in part) based on engagement and information from CRP ○ Adaptation, adoption and spread of innovation associated with participating groups, platforms, and networks
CRP CapDev M&E	Evidence of feedback and improvement from M&E data	○ Number of flagships conducting M&E of CapDev activities ○ Number of programs/projects that capture lessons learned for replication/upscaling ○ Number of CapDev innovations adopted across programs/projects

3.2.4. Budget and Resource Allocations

These budget allocations are based on Flagship Leaders' estimates.

Category	USD	=/> 10%
Salaries of CRP researchers and CapDev staff that would be used on CapDev activities	15,790,000	4.5%
Operational funds for CapDev (consultants, events and activities, materials, etc.)	23,825,000	6.7%

3.3 Gender Annex

3.3.1 Gender analysis in CRP priority setting and research

Gender research has influenced the direction of WLE in various ways, both in the flagships and in the program overall. As the program evolved, the notion of gender and equity (or *equality*), along with the ecosystem framework, has become one of the main upper level questions/hypothesis of WLE. Starting with the gender strategy in 2013, gender research has tackled a variety of issues related to the gendered use and management of water, land and ecosystems. Initially, the work was largely diagnostic, focused on understanding the overall roles and opportunities of women and men within WLE. Understanding the critically important role of social equality, especially gender equality, as a precondition for sustainable development, as mentioned by Leach et al. (2013) and Raworth (2012), has gained traction as a way of framing the work in the WLE flagships. Developing the Phase 2 proposal has provided WLE with an opportunity to reflect on lessons learned, and to build a more concrete research agenda focused on enhancing the role and importance of gender equality.

Overall framework of gender research in WLE in Phase 1. Research and experiences (Quisumbing 2003; Zwarteveen 1997; Valdivia and Gilles 2001) have clearly identified access to, and control and decision-making power over, water, land and ecosystems as prerequisites and entry points for women to actively manage and use natural resources. For WLE in Phase 1, this meant to empower women to deal with, for instance, degradation of land and variability of water supply, they need to have secure access to decision-making power over, water, land and ecosystems; and they need to co-develop solutions, if they are to be major stakeholders in sustainable intensification. In practical terms, this meant developing gender research questions at WLE and flagship levels to integrate gender by identifying and piloting specific entry points. As a result, the goal was to understand how WLE's interventions, models, and solutions in the flagships contributed, or could contribute, to increasing access to and decision-making power over these natural resources, and how we could increase women's ability to contribute to sustainability.

Flagship: Regenerating Degraded Landscapes (RDL*).* Degraded landscapes present numerous challenges to the men and women inhabiting them. RDL gender research focuses on getting a better understanding of these challenges and identifying possible solutions. A large baseline survey carried out as part of a project on "addressing challenges to sustainable land management through social constraints to adoption and designing incentives to overcome these obstacles" in eight communities in East and West Africa is already producing important results. As a reaction to land degradation and consequent food insecurity in Ghana, women are migrating, often seasonally, to seek work as laborers or sellers of small commodities. In Malawi, the poorest women and men respond by selling their labor during peak agricultural times. This cycle of working for others means that work on their own farms suffers. As also found by VCR, the gendered use of ecosystems also emerged in the baseline research, providing researchers with information on how landscapes are valued and used differently, and how proposed interventions can benefit or disrupt essential services to women and men. Innovative, locally-produced solutions for community members in collaboration with partners are also being identified. Two other areas where gender research has influenced the direction of RDL were gender and land tenure, and the need to look beyond tenure if women are to become stakeholders in regeneration (GLF); and the audit of policy documents on gender and the environment in Ghana, which established the existence of significant institutional barriers to using research results (Dittoh et al. 2015).

Flagship: Land and Water Solutions (LWS). Gender research in this flagship concentrated on documenting the ways in which female farmers often face substantial and multiple challenges in

accessing improved agricultural water and land management (AWLM) practices and technologies. These challenges include high upfront investment costs and limited access to information to enable them to make informed investment and management choices. Dessalegn (forthcoming, a) illustrated this with the raised bed technology in Egypt, where access to the machine is the same for both men and women because they have to rent it from the private sector. However, access to the rest of the recommended package, including fertilizers and selected seed varieties, was not equal, as this required significant credit, which was difficult for women to access. Work on irrigation in Zambia and Ghana (van Koppen et al. 2013), and on fuel-saving cooking stoves in Ethiopia (Dessalegn forthcoming, b) also highlighted similar constraints. Research enabled the flagship to reexamine and rethink the stereotypical prioritization of domestic water for women, instead of highlighting the importance of economic empowerment through access to productive water (de Haan et al. 2015).

Flagship Rural and Urban Linkages (RUL). An analysis carried out in Phase 1 showed that gender-specific perceptions of waste and waste reuse can be decisive factors for the success of resource recovery and reuse (RRR) businesses, such as water reuse at scale; and gender awareness in RRR is important in view of access to organic waste resources, information, credit and resale markets. While RRR can create new jobs for women, such as in municipal solid waste, not all waste materials are culturally acceptable/assessable/possible, for example, handling fecal sludge in India (Drechsel et al. 2015). Similar work is being carried out to critically examine the specific roles women play, and can play, within the RRR value chain and within the business models around RRR developed by the flagship. This work is due to be completed by the end of this year.

Flagship: **Managing Resource Variability, Competing Uses and Risk for Increased Resilience (VCR).** WLE Phase 1 research showed that mapping gender and natural resources can provide important insights on priorities regarding access to and use of ecosystems and natural resources. In a unique case study in Ethiopia, “women showed a strong concern over soil fertility, men focus more on grazing lands and eucalyptus, and researchers are heavily focused on crops and farming systems” (Baker et al. 2015). This research, piloted in 2013, influenced a range of projects developed in the WLE focal regions that examined gender-specific ecosystem services. Work by Meinzen-Dick et al. (2014) showed that even where women are disproportionately affected by variability and loss of ecosystem services (as when groundwater depletion affects domestic water supplies), they may not be able to respond because they tend to lack sufficient understanding of underlying biophysical processes. This argues for better understanding of the capacities and capabilities required for natural resource management (NRM), as a basis for designing appropriate solutions. In the absence of such gender-disaggregated knowledge, proposed solutions may well be inappropriate and even counterproductive. In another cluster of work on transboundary river basins, gender-disaggregated data were collected under a project entitled the ‘Four Gender Basin Profiles’ (4GBP). The project collated data for each of the WLE focal regions to build indicator maps and profiles of regional gender issues. These will be used to inform further work in those regions (as part of the gender analysis). This work will be finalized in 2016, but as an initial output there has already been a chapter on gender in a book on the Volta River Basin (Sullivan et al. 2016). The results will be used to inform policy and investment planning in the near future.

Flagship: Enhancing Sustainability across Agricultural Systems (ESA). One important lesson from WLE’s gender work has been the advantages of addressing gender issues right from the start in defining flagship projects and CRP’s problem statement, rather than adding this dimension later. This was a clear lesson from the work of the Integrated Solutions into Policy and Practice (ISP) Flagship (now ESA) in the focal region WLE-funded projects.

These projects provided opportunities to work on gender from the beginning. Thus, each project went through a rigorous selection process and worked closely with the Gender and Inclusive Development team, so that an initial gender analysis could influence the issues that the projects were addressing. The work started in 2015, and a diverse set of results around gender and access, and decision making is anticipated by the end of 2016. For example, in East Africa, the *Harnessing floods for enhanced livelihoods and ecosystem services* project developed a gender strategy and produced a research guide for inclusive development, and an innovative analysis on the gendered implications of changing water distribution when harnessing floods. The 32 projects under ESA will be analyzed and a synthesis report will be available by the end of Phase 1.

3.3.2 Operationalizing gender in the CRP research agenda

Gender impacts on WLE research: Prior to implementation of the gender strategy, the notion of gender equality was not prioritized by WLE. It is now recognized as being critical to achieving sustainable agricultural intensification. The concept is gaining ground and is framing thinking within WLE, but still needs to be fully operationalized.

In Phase 1, the emphasis was on examining how gender research could contribute to enhancing equitable access, participatory decision making, and improving the ability of women to invest in natural resources. Recent results have shown that this agenda was too broad. Therefore, in Phase 2, WLE has developed a more targeted gender-specific research agenda (see section 1.0.4 of the main WLE proposal) looking at specific **gendered capabilities** that need to be strengthened, and **gendered power relations** that need to be understood, to enable more equal access to natural resources, and to facilitate women to become active users and managers of natural resources. WLE's entry points are at landscape and institutional levels. By the end of Phase 2, this research will have identified new insights, policy and reform options, implementation strategies, and investment opportunities for achieving gender equality in the countries and regions where WLE works. This work will be implemented with agri-food system (AFS) CRPs and other partners. Promising areas of work are identified below.

Using the baseline developed on gender-differentiated uses of and access to ecosystems, the **RDL Flagship** will prioritize enabling women to engage in restoration and regeneration efforts. This will be done through: 1) understanding the gendered power barriers to resource access and landownership; 2) calculating the costs and benefits of these services to different community members; and 3) building on successful community initiatives identified in Phase 1 for out-scaling in Phase 2.

LWS Flagship research has demonstrated the multiple challenges women face in accessing improved AWLM practices and technologies. It will now prioritize identifying opportunities to remove these barriers and strengthen women's capabilities to reduce their work burdens and increase agricultural productivity. This will be done as part of research conducted on how higher returns can be gained by tailoring AWLM practices and technologies to meet the specific needs of women, and developing innovative pathways and investment options to catalyze gender equity.

The **RUL Flagship** has prioritized gender-specific research in several areas: 1) a comparative analysis of gender-specific income along traditional and exotic vegetable value chains in urban and peri-urban West Africa; 2) assessment of economic impacts on women and men of potential changes in fuel (towards waste-based alternatives) and cooking equipment in northern Ghana; and 3) an analysis of opportunities for women in businesses based on nutrient recovery from domestic and food waste for agricultural reuse.

The **VCR Flagship** will aim to understand the potential of gender-equitable institutions to deal with water variability, scarcity, degradation and competing uses within ecosystems. Researchers will carry out institutional analyses focused on how gendered power relations within institutions affect women who could benefit from options developed to manage water variability, scarcity and degradation. VCR will also explore how the concept of capacities or enhanced knowledge of ecosystems can contribute to more resilience and empowerment over resources for women.

The **ESA Flagship** has prioritized examining how access to and benefits from natural resources change within different agri-food systems in collaboration with AFS CRPs, and assessing current power relations and capabilities to identify key change agents and leverage points to advance gender equality through uptake of ESA research. It will develop and test a toolbox of possible solutions.

Gaps in operationalizing gender research in WLE. WLE has developed a more coherent and targeted approach to gender and NRM. At flagship level, there is awareness of the issues, and each flagship has one or two pieces of research that has influenced the flagship priorities and research investments, and several have housed it in specific clusters of activities (CoA), i.e. RDL in CoA 1.1. In the near future, more **interactions on gender capacity development** are needed within and between the flagships. WLE will also need to develop a more systematic approach to **identifying opportunities, collecting data, and assessing progress and impact**.

Most past gender research has been done at intra-household level. In Phase 2, WLE will focus on examining gender issues at **landscape and institutional levels**, looking at institutions as actors that often maintain gender barriers but also offer possibilities for enhancing opportunities. This is an innovative area of work, which will require time to demonstrate results.

Institutionalizing gender research within WLE*:* All WLE work is expected to contribute to the crosscutting the CGIAR Strategy and Results Framework and the GID theme. The work is led by WLE's GID core theme, working with the WLE flagships and AFS CRPs. A main aim will be to improve the prioritization and determine the gender research agenda within the flagships and the CRP, so as to be more responsive and transformative in the next six years. Two mechanisms to operationalize this research will be used: 1) implementation of a specific gender research agenda; and 2) strengthening the capacity for flagships to integrate gender into their research. Each flagship will develop a **three-year gender research plan**, assisted by GID. These work plans will ensure that: 1) sufficient gender research capacity is available and allocated in each flagship (and where necessary, recruited); and 2) gender research is well-integrated into key elements of the flagship portfolio and not perceived as a separate franchise. GID will embed a gender specialist within each flagship. GID will also continue to be an active player in the CGIAR gender network or platform as it develops.

To strengthen gender research capacity in Phase 2, and in line with recommendations from the CGIAR Independent Evaluation Arrangement (IEA 2016), WLE will provide gender capacity building support through: 1) a virtual advisory committee whose function will be to guide the research; and 2) gender training and awareness workshops and interactions to develop common frameworks and approaches.

Partnerships: WLE's gender research partners include the Institute of Development Studies (IDS, UK), Wageningen University (The Netherlands), Institute for Poverty, Land and Agrarian Studies (PLAAS) (South Africa), Pennsylvania State University (USA), and national universities. Through such partnerships, we can leverage additional resources, for example, to support female as well as male PhD and postdoctoral fellows. WLE will collaborate with AFS CRPs to generate gender analysis tools

and methodologies applicable to integrating gender priorities, NRM and crop value chains. WLE will also collaborate with the CGIAR Research Program on Policies, Institutions and Markets (PIM), combining its capabilities on intermediary institutions, and water and land management with PIM's strength on land tenure.

In addition, GID will work with WLE's international boundary partners. These include the World Bank, Asian Development Bank (ADB), African Development Bank (AfDB), regional economic communities (e.g. East African Community [EAC] and Economic Community of West African States [ECOWAS]), the Food and Agriculture Organization of the United Nations (FAO), International Fund for Agricultural Development (IFAD), Global Water Partnership (GWP), and the United Nations Development Programme (UNDP). Through these and national partners, WLE supports transformation of gender relations in the management of water, land and ecosystems.

Monitoring and evaluation: Progress will be monitored as part of WLE's Monitoring, Evaluation and Learning (MEL) system. WLE will continue to systematically collect information on the gender research dimensions of its projects, gender outputs and possible outcomes. The three-year gender work plans will also be important monitoring tools. The detailed impact pathways to be included in these plans will enable monitoring progress in achieving specific gender-related measurable outputs and outcomes.

3.4 Youth Strategy

3.4.1. Background

WLE is developing a youth-inclusive research agenda and approach to sustainable intensification in which a healthy functioning ecosystem is seen as a prerequisite to agricultural development, resilience of food systems and human well-being. WLE's starting point is to equip young men and women to be major stakeholders and active participants in agriculture and natural resource management (NRM), by raising their confidence, promoting youth leadership, and enhancing their ability to build successful careers and have an active voice in decision making in agriculture and NRM. A two-pronged approach is required: at an individual level, appropriate capacities and capabilities need to be developed to take up irrigation, and other agricultural and NRM technologies. At a structural level, research will identify opportunities for policy and institutional reforms to enable youth to benefit from water, land and ecosystem access. The aim is to identify how to enable rural and peri-urban youth to become sustainable and entrepreneurial farmers, managers and professionals.

3.4.2. Youth - Why involve them?

In 2012, Asia had a population of 4.3 billion people. More than 750 million of them were young women and men aged 15 to 24 years (UN ESCAP 2012). The sheer number and demographic profile of young people in Asia affects the socio-economic development of the region, as governments attempt to address the "dramatic changes in young people's lives" brought about by "the shift from traditional agriculture toward an industrial, export-based economy" (East West Center 2002). In Africa, half the population is under the age of 25 (Filmer et al. 2014), and a majority live in rural areas. Six in 10 rural people around the world are young people (IFAD 2012a), deriving their income from agriculture, and providing most of the labor to agriculture and other rural endeavors (IFAD 2012b).

There are at least three reasons to involve youth in WLE. First, **youth will bear the consequences of today's decisions.** This makes them relevant stakeholders, and they should have a voice in the interventions and actions that need to be taken to slow down, and even reverse, the degradation of ecosystems and natural resources. Second, **youth are critical to finding solutions and educating others.** Diverse initiatives are spearheaded by young people to address socio-ecological problems. Developing confidence and space for youth leaders to provide technical and policy inputs to negotiating groups, and engaging with decision makers through high-level meetings and in informal settings can generate novel solutions (UN n.d.). Third, **youth bring energy, vitality, and innovation** (IFPRI 2012) **into the sustainable management of ecosystems.** Engaging youth can be transformative for societies, for both economic growth and social development. Pairing this with the need for increased agricultural growth, tapping into youth will provide a substantial 'youth dividend'.

3.4.3. WLE Research framework for empowering youth for Water, Land and Ecosystems

A key objective for WLE in Phase 2 is to examine NRM roles, and the impacts of sociocultural and economic differentiation and of male and female youth. WLE plans to identify how shifts in intergenerational practices, and involvement with water, land and ecosystems affect diverse groups of youth within varying social, economic and environmental agricultural contexts in the WLE regions. WLE will analyze the influence of various age-related perceptions, choices, practices, knowledge, skills, power relations, decision making, opportunities and risks on accessing water and land, and related factors such as agricultural inputs, markets, and finance.

WLE will also identify the roles and impacts of youth within agrarian transformations. We will specifically look at the heterogeneous nature of youth, and develop approaches to deal with it. Research shows how rural out-migration impacts the functionality of water and land management institutions, leading to a reduction of intergenerational transfer of agro-ecological knowledge (Punch and Sugden 2013). This is a highly gendered process, as primarily young males migrate, leading to the aging and feminization of agriculture. WLE has also tackled the changing perceptions and aspirations of youth, as a participatory video project in Nepal (Clement and Sugden forthcoming) provided evidence that seeking a job and increasing income are also relevant for young women, while prior generations relied on getting married for social advancement. Much of the work in Phase 1 on youth has concentrated on Asia, but WLE will expand to Africa as well in Phase 2.

To reach its goal of youth being effective stakeholders in agriculture and NRM, WLE has developed a research framework for examining research areas crucial to empowering youth for water, land and ecosystems (*Figure 3.4.1*).

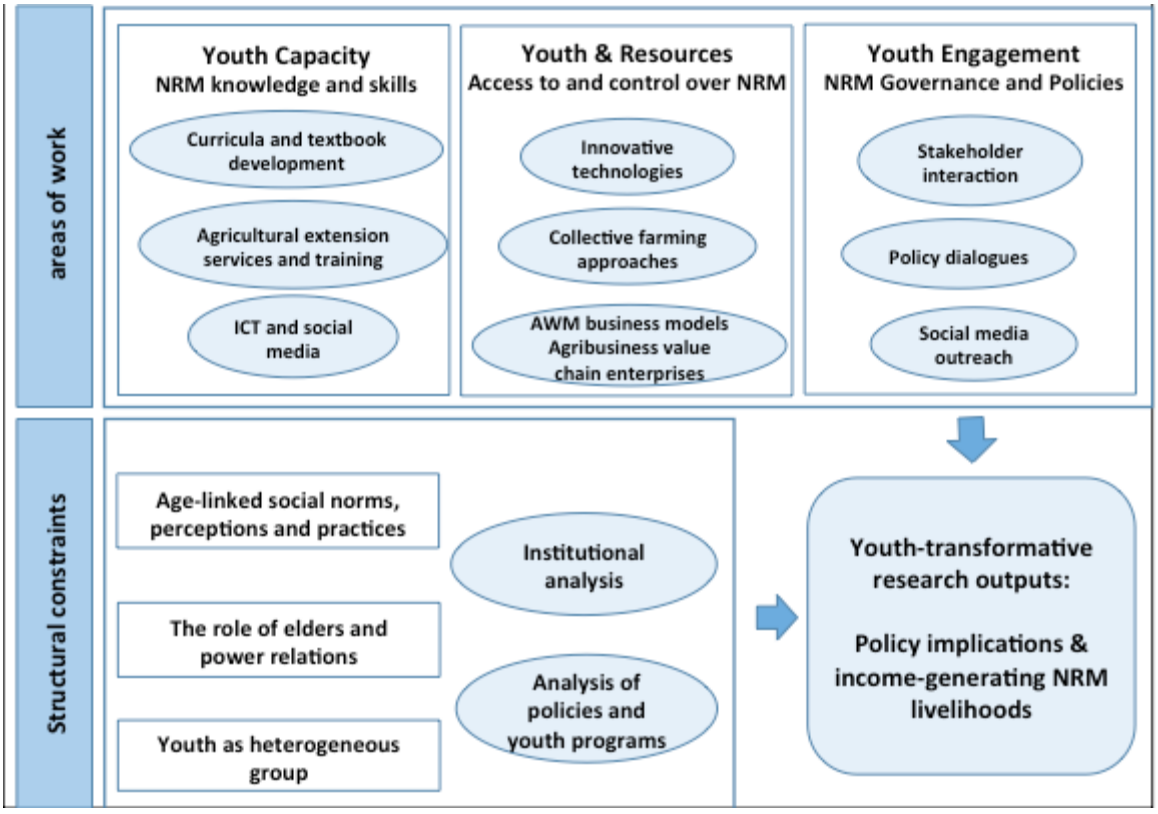


Figure 3.4.1. WLE Research Framework for Empowering Youth for Water, Land and Ecosystems
Notes: *ICT - information and communications technology; AWM – agricultural water management*

The framework asks four questions:

1) What are the structural opportunities and constraints for youth to access and invest in NRM?

Empirical evidence from WLE and other research projects in the Eastern Gangetic Plains has identified how, *alongside* a patriarchal system, the dominance of elders limits the ability of youth to take over farm and NRM responsibilities. Building on this understanding and working with its partners, including interested AFS CRPs, WLE will critically examine how underlying age-linked social norms, perceptions and practices exercise power over youth and prevent them from achieving their potential for productive agriculture. This includes comparative institutional and policy analysis on structural constraints in accessing natural resources in all WLE focal regions and selected CGIAR

country integration sites. WLE and its partners will systematically evaluate the impact of existing policies and implementation programs on youths' knowledge, skills, and access to and control over water, land, finance, markets and decision-making processes. We will investigate these interrelations and the context-specific requirements for different groups of youth, and identify conditions under which policies and interventions have failed to address these issues.

2) How can capacity development of youth on NRM be promoted?

Educational material highlighting NRM could potentially have a great impact on the next generation of rural and peri-urban youth. Since the knowledge and skills acquired through the formal educational system depict agriculture as an undesirable livelihood (Leder 2015), WLE plans to collaborate with AFS CRPs to develop methods to integrate knowledge and skills on sustainable agricultural intensification, traditional agro-ecological knowledge, modern agribusiness models and value chains in curricula and textbooks for business and formal schools. Further, WLE aims to promote access to, and quality of, agricultural information, and capacity and skill development by promoting the reform of agricultural extension services for youth, ICT and social media use. We will build on ongoing research in the RUL Flagship to promote business curricula, and training and enterprise development on options for turning agro-industrial and urban food waste into assets with market value, with direct benefits for urban youth through job creation and capacity development, and indirectly through an improved living environment.

3) How can resource access and income-generating opportunities be promoted for youth?

WLE will build on existing pilot projects to identify wider-scaling strategies for youth employment opportunities through innovative interventions, collaborative farming approaches, agricultural water and land management (AWLM) business models, and agribusiness value chains for regional and global markets. WLE will build on the learning from the WLE project which has been piloting new solar irrigation and collective water distribution systems, whereby marginal tenant youth farmers take joint leases for plots of land to farm as a group. This approach encourages youth to see the potential for improved incomes on the farm, and develops enthusiasm for new technologies and joint farming, so migration is not automatically considered the only livelihood choice. Further, WLE will build on stakeholder and institutional analyses involving flow management, sanitation and pollution control by the WLE project '*Restoring the Ganges*', which is identifying how equitable engagement of women and youth in pollution control increases agricultural activities. Concerning the growing urban farming sector (Thebo et al. 2014), which is particularly attractive for rural youth, WLE will continue to develop innovative options for enterprise development along the value chains (from farm to trade and input supply) as well as in advanced farm support services (irrigation optimization, marketing, soil fertility enhancement and farm-IT), through the RUL and other flagships, and in collaboration with the AFS CRPs.

4) How can youth engage in natural resource governance and policy dialogues?

WLE proactively plans to collaborate with young farmers, young researchers, youth organizations, teachers, curricula and syllabi designers as researchers, and not only see youth as research subjects. We will work closely with schools, universities, and extension services to develop educational and agricultural approaches to create incentives for youth to engage and invest in sustainable natural resource intensification. WLE research on sustainable agricultural development tackles intergenerational justice by recognizing the voice of youth in NRM and by integrating youth as relevant stakeholders in ecosystem service-based approaches to sustainable intensification. WLE will identify opportunities for youth voices through stakeholder interactions and (social) media outreach

to influence policy discussions and debates to address social differences for policy framing and response (Sumberg et al. 2012). With policy briefs and youth research outputs, WLE will contribute to identifying necessary policy changes for curriculum and capacity development opportunities, and water and land rights.

3.4.4. Implementation

In Phase 1, youth already started emerging as an issue for WLE, as shown above. In Phase 2, it will gain more prominence, and WLE will develop a full youth strategy within the first year. We will develop a strategy of engaging with both the WLE flagships and AFS CRPs, sharing accountability and responsibility. Initial discussions have already started with the CGIAR Research Program on Forests, Trees and Agroforestry (FTA), and the CGIAR Research Program on Dryland Cereals (DCL). This will be supplemented with a funding strategy, looking for ways to seek additional W3 and bilateral funding to strengthen the research conducted on youth. We will further develop and target the research questions and designs within WLE to address youth-related issues. WLE will invest in developing age-sensitive and multi-disciplinary tools, methods and analyses to research awareness raising, capacity building and decision-making processes in NRM, and to improve investments and decisions by youth on sustainable intensification.

3.4.5. Outputs and Outcomes

The outputs of WLE's youth-transformative research approach will be evidence-based knowledge of the conditions and solutions for age-specific institutional changes and policies. These are necessary to provide different groups of youth, including young women as well as men, with opportunities and incentives through resource access, knowledge and skills to engage in NRM.

WLE will seek to influence development choices to improve sustainable agricultural intensification through youth-inclusive approaches by:

- providing evidence that youth-inclusive solutions contribute substantially to achieving improved food security, equity, livelihoods and healthy landscapes;
- integrating youth in solutions to better manage risks related to climate shocks, and competing uses as well as models and scenarios to understand trade-off and synergies; and
- improved youth-inclusive management practices will be achieved primarily through participatory action research at the community and landscape level in order to promote learning and adaptive management.

WLE will use these outputs as evidence and solutions that can provide strategies to achieve the institutional changes and policies necessary to provide youth with opportunities, incentives, knowledge and skills to engage in agriculture through access to water, land and ecosystems. WLE will aim to support the emergence of youth leaders and strengthen opportunities for youth to take the lead in achieving sustainable intensification of agriculture that brings them tangible benefits.

3.6 Results Based Management

3.5.1 Purpose

WLE's results-based management (RBM) strategy responds to the CGIAR Strategy and Results Framework (SRF) for 2016-30. It provides the conceptual underpinnings and operational approaches that guide how decisions will be made within the program based on a clear intent to achieve specific results, including how the program will learn and adapt to retain its relevance and focus. This section also explains the role of monitoring and evaluation (M&E) within the RBM system, providing the evidence base which will inform the decisions and direction.

3.5.2 Elements and Approach

The CGIAR Independent Evaluation Arrangement (IEA) describes RBM as "a management strategy focusing on performance and achievement of outputs, outcomes, and impacts." (IEA 2011). In research, the level of control over outcomes and impacts is typically less than in development programs, and the timeframe for realization longer. Thus, the focus on clear and relevant theories of change and impact pathways is critical to justify the investment *ex-ante*, while the ability to manage based on these results requires a robust implementation plan that can be used to review and adjust course. While the actual outcomes and impacts at scale cannot always be directly monitored, it is possible to track more immediate, "research" outcomes. In addition, the plausibility of the ToC as a whole and the likelihood of achieving outcomes and impacts can be assessed.

While recognizing that a comprehensive approach to RBM includes a range of organizational, staffing, financial and external stakeholder views, WLE will build on the lessons from the phase I RBM pilots (see Box 1) to focus in particular on the interface between data, results and value for money through the following four elements of RBM: c**larity of the results** – specificity of the relevance and measurement; **incentive mechanisms** to achieve results; **data and evidence generation** through monitoring, evaluation and impact assessment; and **learning, reflection and adaptive management** based on what the evidence says, how the circumstances have changed, and how the program can improve.

Box 1. Lessons From The Phase I RBM Pilots

The approach to RBM is based firmly on the lessons from the pilots conducted in a number of CRPs during phase I, including recognition that moving towards results management is not a one-off event, but a carefully managed process which takes resources, time and a commitment from managers. The advantage of a pre-established SRF with CG-wide outcomes provides a useful framework to guide this process in phase II, both within and across CRPs. Two areas in particular build on these lessons. Firstly, the need to address incentives and incentive structures for flagships, projects and project partners in moving towards a culture of results, based on reflective learning and improvement. Secondly, the need to identify areas for common work across CRPs. WLE has responded to this by agreeing jointly with other global integrating CRPs: CCAFs, PIM and A4NH, to establish a common information and communication technology online platform (see further information in this section).

Definition of results: The specification of results in WLE, in line with the IEA glossary, focuses on a) key outputs – the critical products and services produced by the program; b) research outcomes – the direct uptake of these products and services by next users, including the associated changes in capacity, behavior and practice implied; and c) development outcomes – the application of these direct results and changes at scale on the target individuals, communities and systems. These development outcomes are in some cases correlates or measures of SRF sub-IDOs, and represent the logical contributions to SLO targets. Supporting this is the formulation and role of assumptions in the

realization of outcomes, the strength of evidence behind these, and the mechanisms for their review and revision.

In the first phase of WLE, an active program of results specification was initiated, targeting key outputs, priority research and developments outcomes. This implied capturing or reconstructing baseline data, establishing clear metadata around the definition, location and scale of changes sought, who and how data and evidence would be captured, and when and how it will be presented. In the second phase, WLE will focus on, inter alia, the following initiatives to better refine results:

1. As part of the work under Flagship 5.2 on decision support analysis, and in line with the recommendations of the IEA Evaluation of WLE (IEA 2016), the impact of a sample of projects and clusters of activities (CoAs) will be estimated (with uncertainties) in advance (i.e. quantified impact pathways), then actual versus predicted performance monitored down the chain, focusing on the more uncertain variables that have a large influence on outcomes (i.e. those with high information values).
2. In 2017, robust baselines will be established for key outcomes, building as appropriate on data collected during phase I, in particular targeting site integration countries and co-investing with other CRPs where data needs match. Relevant targets and milestones presented in the performance indicator matrix (Table D) will be reviewed and revised. ToCs and IPs will be revised and updated as appropriate.
3. A set of indicators that focus on SRF IDOs and sub-IDOs to which WLE will contribute has also been prepared based on an extensive review of the literature of available statistics, aligning with the SDGs where possible (Table 1 below).

The WLE approach to RBM focuses on both documenting evidence of achievement of outputs and research immediate outcomes (focus of the monitoring strategy), combined with building a convincing case that longer-term outcomes and impacts are likely to be achieved cost-effectively (focus of the learning strategy).

Performance based allocations and non-financial incentives for results: Creating incentives to achieve results through relevant, high quality research is central to the success of RBM. The greatest incentive mechanism is through the allocation of budget while also recognizing that this can and should be effectively supported by non-financial incentives.

While the fiscal space for performance-based allocations is narrow due to the limited share of W1/2 funding, the lessons from phase I of WLE indicate that some financial incentive to keep focused on the strategic, demand-led selection of projects (including the bilateral projects mapped to the program) and in the achievement of results will aid the progress of the program as a whole.

W1/2 funding will be used to finance strategic, catalytic actions to capitalize on the W3-Bilateral funding, e.g. piloting scaling, and to pay for synthesis. To empower and stimulate RBM, Flagship Leaders (FLs) will be able to reallocate resources between projects and outputs twice during the program cycle based on cumulative performance assessment (see Section 3.6.3). Up to 25% of a project's budget can be reallocated by the FLs to other, better performing, projects and/ or outputs for Years 3 and 4 (based on performance in first year and a half) and for Years 5 and 6 (based on aggregate performance in Years 1-3). The performance reporting system scores all outputs and progress along the impact pathway of projects on a red/ amber/ green basis annually. Depending on possible extenuating circumstances for non-delivery (type of project/ impact trajectory timescale, natural disaster, political issues etc.), the FL *may* recommend to reallocate a proportion of funds from a red output/project to one of the green projects that has the potential to yield good results. A case of proposed reallocations will be made by the FL to the MC and the Program Director after consultation with the SC. Amber-rated projects will not be subject to fund reallocation, but will be reviewed and any remedial actions proposed and tracked.

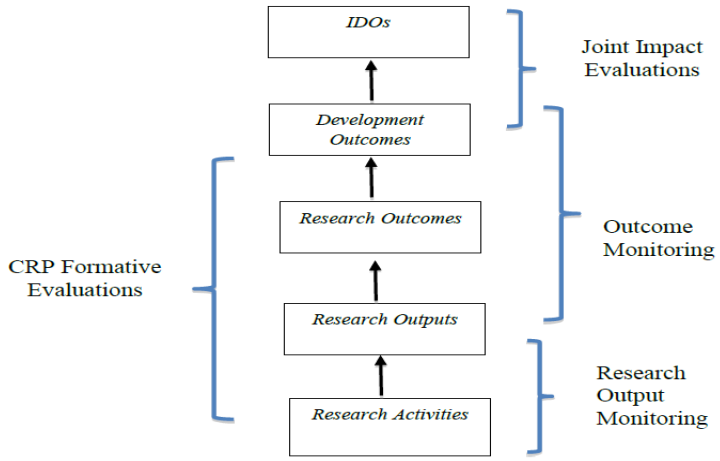
The effectiveness of this proposed system requires not only the appropriate and transparent application of results measurement, but also clarity on the level of budget ownership with FLs in terms of tracking, reporting and revising (and hence the CoAs over which they have some influence), and the rules and expectations around annual variances for flagship and participating partners' budgets.

In addition, WLE will also include non-financial incentives for performance and results. Drawing on evidence from the behavioral literature these will include putting additional focus on synthesis and sharing of research results during the program as a form of recognition of achievements (based on early cycle or indicative results as appropriate), and on providing opportunities for individual and team growth (e.g. additional training or conferencing opportunities) for higher performing teams.

3.5.3 Monitoring, Evaluation, and Impact Assessment

This section outlines WLE's approach to monitoring, reporting, evaluation and impact assessment, and learning from the evidence generated. These are elemental parts of the program's overall RBM strategy, founded on the systems and practices established in Phase I and revised and adapted as appropriate during the life of the program. The basic schema outlined in Figure 1 will guide the types of assessment to ensure strategic coverage.

Monitoring:



Source: Mayne, J, 2014, An RBM for CRPs, Draft for discussion, 28 Nov 2014, p.7

Figure 1. Measuring Along the Impact Pathway

WLE's monitoring will focus on results – the outputs and outcomes that the program has set out to achieve. Given the share of the budget from W3/bilateral financing, and the associated monitoring and reporting requirements with such funds, the focus of the CRP monitoring will be focused on W1/2 financing, and the contribution of all projects to the key outputs and outcomes that are central to the program-level and flagship ToCs. This approach avoids duplication as Centers, not CRPs, monitor the deliverables and outcomes produced by individual W3/bilateral projects that make up a large part of the CRP portfolio. More importantly, it allows the program to focus on the CRP-level results that are achieved through coordination across projects, Centers, and partners.

Monitoring will be at three levels:

- Project monitoring based on research objectives and time-bound outputs and outcomes for a target group of users defined in multi-year agreements with participant centers and

partners. Self-assessment is carried out by project leaders twice per year, in September (to feed into project planning for the next year (n+1)) and in January as the year-end report. A set of questions will require project leaders to consider their progress towards the results defined in project documents and relevant flagship theories of change, risks and assumptions, and spending. This information is uploaded and captured in the online platform (see Box 2).

- Flagship monitoring is based on key strategic results and outcomes drawn together from clusters of related activities. These are few in number, and represent the major flagship products, services and outcomes to which the program as a whole is striving along the impact pathways. Progress towards these is monitored annually by FLs, with the information clustered and aggregated up from the project level through the online system.
- Program-level monitoring focuses on the contribution of research outcomes to the developmental outcomes and correlate sub-IDOs, SRF SLOs and SDGs as appropriate. Establishing the basis for monitoring change at these higher levels requires collaboration across CRPs, Centers and external partners – notably national statistical agencies – focusing in particular on the site integration countries in which WLE is operating. The details for this will be worked out during the latter part of 2016 and early 2017 based on, inter alia, the selection of high level IDO/sub-IDO indicators identified here in Table 1.

Data collection and validation: A performance monitoring plan will be updated from the phase I version to describe how the program will be monitored – what information will be collected, how often, by whom, and with what resources. This will be embedded in the online platform described in Box 2. Responsibility for implementing the plan will be shared between FLs and the PMU. In most cases, documenting progress on outputs and immediate outcomes is by WLE projects and therefore the regular work of FLs, researchers, and project teams (including partners). This will be facilitated by the online monitoring and reporting system. In some cases, however additional technical or financial resources will be required to adequately document an outcome and these will come from PMU.

To facilitate planning, monitoring, and reporting aligned with CGIAR guidelines on monitoring systems, WLE will work with CCAFS, A4NH and PIM to adapt the CCAFS online Planning and Reporting (P&R) system for use by WLE and all other integrating CRPs (ICRPs). The online tool will contain the ToC-based monitoring information and allow the PMU and FLs to check the status of particular outputs or outcomes, make decisions to improve the implementation of projects, and facilitate reporting across the different partners in WLE. The tool will be managed overall by the PMU M&E manager, but responsibility for the content will rest with FLs and researchers as well as PMU. The online tool will be operational in 2016, resources and reporting guidance from CGIAR permitting.

Project level monitoring will be validated by an oversight panel to ensure that it is robust. This is critical not only for accuracy, but also for the effective functioning of the proposed performance allocation system detailed above. The oversight panel will consist of the FL (for projects which they do not directly lead), one member of the PMU and one external expert. Project leaders / teams will conduct their own self-assessment, and the oversight team will independently conduct an assessment based on the data presented. Scores will be reviewed (based on a red / amber / green system) against agreed criteria, including output delivery, progress towards outcomes, quality of partners, communications and gender and youth work, evidence of adaptation based on evidence, and the quality of reporting. The scores of the oversight panel will be averaged and used as the basis

for decision-making and discussions with the project teams. This system has already been successfully piloted by CCAFS.

Box 2. Information and Communication Technology Online Platform

All of the integrating CRPs (ICRPs): WLE, A4NH, CCAFS and PIM have agreed on the fundamental conditions of a single, integrated online ICT platform to be in place from 2017 onwards. The process of designing this platform began in February 2016. The advantages of cross-CRP collaboration on a single ICT platform include reduced transaction and management costs, standardization of nomenclature and frameworks, and with time the integration and aggregation of data across the participant CRPs. This is expected to benefit both the CRPs involved, and the CG system as a whole (with and through the Systems Office) in terms of providing automated data and information on planning through the annual Plan of Work and Budget, reporting and with time, on progress towards the SRF SLOs. The system will be interoperable, enabling data to be accessible and usable by other CRPs and the System Office.

The online ICT platform covers the CRP program and project management cycles, including pre-/ and planning, monitoring, reporting, and synthesis. The platform is structured around the theory of change at programmatic, cluster and project levels enabling the inclusion and review of key results and assumptions on a periodic basis. It is primarily a program management tool designed to address the requirements from a programmatic (CRP) perspective, as well as contribution to the CGIAR SRF. The platform being developed is based on the existing CCAFS planning and reporting system which is being modified to meet the requirements of each CRP while adhering to common principles.

WLE and its lead center, IWMI are also working towards aligning their planning and reporting. An initiative is underway for IWMI to adopt the nomenclature and frameworks proposed in the new P&R system to fit its center needs to map and monitor its high level impact pathways to ensure a harmonized monitoring and reporting framework.

Reporting: WLE will comply with reporting requirements of the CGIAR and other key external stakeholders. The program will provide, at a minimum, annual performance reports to describe what WLE is learning and achieving and will focus on updating stakeholders on progress towards achieving the main results expected for that year. Like WLE's approach to monitoring, the approach to reporting is to describe the progress along the CRP's and flagships' impact pathways, which will include a combination of outputs and outcomes achieved and updated assessments, based on research results, of the likelihood that WLE with its partners will deliver on the IDOs and SLOs.

These reports will come in various forms to serve different audiences. Progress scorecards focusing not only on results but research evidence will be provided to the WLE MC and SC on an annual basis, and feed into the annual reporting to the System Office. September reporting will be light, but sufficient in detail and quality to guide strategic and allocative decisions about the following year projects (n+1).

Evaluation and impact assessment: The selection of what to evaluate and assess will be guided by criteria that should ensure strategic coverage of the range of results and innovative research conducted across the program, in particular focusing on work initiated or conducted during phase I of WLE, to allow for the results to have been realized based on the anticipated impact trajectories. The criteria, informed by the IEA independent evaluation of WLE (IEA 2016), include the scale of intervention, degree of innovation, strategic importance to the flagship or region, the availability of baselines and data (for *ex-post* or retrospective studies) and the global public good value (in terms of addressed evidence thin areas).

In terms of specific issues, topics and initiatives, the opportunity for evaluation and impact assessment in WLE-related areas is considerable. Merrey (2015), notes that "the CGIAR has seriously

under-invested in both *ex-ante* and *ex-post* economic, social and environmental impact assessments of its work on irrigation and water management." The set of studies proposed in Table 2 (below) aims to start to redress this imbalance.

Reviews and evaluations represent systematic studies of an in-depth nature using clear evaluation criteria (IEA 2016). Reviews tend to be more internal, possibly less rigorous but certainly quicker, while evaluations are more independent and thorough. The purpose of such exercises is to learn what is working and why, with a particular focus on policy and programmatic work over large time periods, and on specific mechanisms and practices where there is something specific to learn. The current indicative evaluation plan includes four reviews and evaluations during 2017-22 focusing on different themes and structures, including plans to conduct a joint review with the other ICRPs around the effectiveness of the integrative activities which these CRPs are responsible for – to see what's worked and what hasn't – and learn from each other.

Impact evaluations allow for the rigorous estimation of the impact of an intervention or set of interventions. The goal of these studies is to get an accurate and unbiased estimate of the size of the impact on development outcomes. Experimental and quasi-experimental methodologies are typically employed to ensure rigor in attributing change to the intervention, and hence the cost can be considerable and thus the focus is typically on a relatively small scale. These types of studies are generally conducted as part of the research agenda of a specific flagship. Given the cost of the studies, they will need to be funded entirely or largely through W3/bilateral grants. In WLE, five impact evaluations are currently proposed during phase II, the majority of which are currently in the bidding phase with 3iE. In addition, as noted in the section above on result specification, WLE will engage with other CRPs active in the site integration countries to establish a basis for common data collection for SRF SLOs and future impact evaluation on work areas of common interest.

However, it is recognized that these designs are typically more appropriate for some types of research (e.g. technology adoption) than others (e.g. policy research). Credible, convincing evaluations of returns on investments in true IPG policy and natural resource management research are very rare. It is extremely challenging to attribute poverty, food security, environmental or nutritional impacts to specific research outputs because of all the multiple impact pathways, competing, complementary and independent sources of influence other than the research, the complexities of understanding human motivations, and the long time lag between research and impacts. Linear pathways based on simplistic models of human behavior are not adequate. Merrey (2015) notes that the CGIAR needs to broaden its repertoire of impact assessment tools to include, for example, contribution analysis, and this will be explored by WLE in 2017-18 to see which outcomes might lend themselves towards more qualitative investigation.

Impact assessments estimate the benefits of use at scale of research outputs and outcomes. A variety of methods are possible, generally based on secondary data, modeling or on expert opinion. For *ex post* assessments, WLE is proposing to look at two major areas of work. One is the Ag-water Solutions Project funded by BMGF which involved multiple partners to generate new insights and water management investment opportunities in Africa and Asia, particularly over the period 2009-12. The other is IWMI's signature work on Asian large-scale irrigation, 1984 to the present where there has been a focus on improving the performance and management of Asia's large-scale irrigation systems. This work continued under WLE but no assessment has been made of the quality, influence and impact to date.

In addition, WLE plans to include elements of meta-synthesis in some of its studies that assess outcomes across projects to provide an understanding of the effectiveness (or otherwise) of different approaches to addressing key development themes within the program.

3.5.4 Learning to Change

Strategic reflection, learning and adaptive management: Accountability and adaptive management are central to RBM. Since RBM is fundamentally about management, it requires a way to link results to the real-time decisions that CRP managers make in the implementation of a collaborative, multi-institutional, multi-donor, research-for-development program. Evidence from the monitoring and evaluation systems will be fed back through the governance arrangements of the program, with MC and SC meetings receiving and debating evidence to guide implementation and address allocations as appropriate.

There will be a specific focus in WLE on learning across and within flagships, where detailed ToCs can be tested and validated, presentation and sharing of early stage results, reviewing assumptions and failures – all contributing to results-based adaptive management. These will include:

- Annual science meetings and regional meetings - important spaces to share results across the program as well as to synthesize learning. While resource intensive it is important to have a platform to share on a regular basis.
- Working groups on cross-cutting themes and topics: the Ecosystems Services and Resilience Working Group, Gender, Spatial Analysis and Modelling working groups were good examples from Phase I of how cross-cutting issues and themes were shared across partners.
- Evidence-based case studies: drawing on the investment in rigorous data collection and analysis across the CoAs, by Year 3 it is expected that there will be bodies of evidence being compiled around key programmatic initiatives. Evidence being gathered with other CRPs around the SLO targets and sub-IDO indicators will also become available. Case studies and reports will provide an 'evidence' meeting point drawing in not only WLE and other CGIAR personnel, but a wider group of interested parties.

Analysis of the information generated through the online platform is a key source of learning at the project level, and will generate lessons about particular outputs and outcomes. These results, together with information from other sources and with researcher and partner experience, will be used to regularly assess and update the ToC/IPs. Part of this assessment involves assessing whether the pathway itself (the sequence of outcomes) is appropriately specified. Another part is whether the links in the pathway are likely to hold through looking at the assumptions that underlie them and whether there is evidence supporting them. As part of the development of the WLE flagship ToCs, an initial assessment and rating of the evidence for assumptions and the likelihood of outcomes is being conducted based on the first phase (e.g. RRR/RUL). This assessment will be conducted for the remaining ToCs, and each will be regularly re-assessed and updated by flagship and cluster teams through the online system, with support from the M&E manager. Over time, the ToCs of the individual flagships and the overall CRP will adapt based on the evidence generated, creating improved clarity on the best pathways towards to SRF targets.

Budget allocation: Financing of monitoring, evaluation and learning will be drawn both from the PMU and flagship budgets. Core financing of the online platform, a contribution to the reviews and evaluations, and the staff costs of the MEL manager and interns will be included in the PMU from W1/2 budget allocations. Impact evaluations and *ex-post* impact assessments will be largely funded from flagships and the participating centers, drawing predominantly on W3/bilateral funding and through obtaining direct financing from impact evaluation financiers such as 3iE. Projects will be set up in each CoA specifically to cater for impact assessment/impact evaluation and data work. A percentage of FLs' time (c.20%) and PLs' time (c.10%) will be allocated to MEL activities.

Table 1. Proposed set of WLE-Focused Sub-IDO Indicators

SUB-IDO	PROPOSED INDICATOR	HOW	WHERE	FREQUENCY
Improved water quality	Microbial water quality indicator (faecal coliforms)	Biannual water quality monitoring starting 3 years after policy has been	Target urban conurbations	Bi-annual
Land, water and forest degradation (including deforestation) minimized and	Area under sustainable land management	FAO initiated process - new indicator - looking at crowd sourcing the data	TBD	TBD
Increased genetic diversity of agricultural and associated landscapes	Allelic diversity	Measured through proxies of the total number of crop (including tree) varieties, animal breeds, and aquatic diversity, together with their proportions occurring within a set	National level aggregates in target countries	TBD
More productive and equitable management of natural resources	Percentage of agriculture area under sustainable agricultural practices	FAO data source on percentage of agriculture area under sustainable agricultural practices	National level aggregates in target countries	Annually
More productive and equitable management of natural resources	Number of national development plans and processes integrating biodiversity and ecosystem services values	Assessment of National Development Plans	National level in target countries	As and when national plans are published
Agricultural systems diversified and intensified in ways that protect soils and water	Proportion of food produced by sustainable agriculture	FAO data source on percentage of agriculture area under sustainable agricultural practices	National level aggregates in target countries	Annually
Agricultural systems diversified and intensified in ways that protect soils and	Share of cropland area with efficient irrigation practices in place	WLE/IWMI Water Accounting Tool	River basins/ target catchments	Periodic
Enrichment of plant and animal biodiversity for multiple goods and services	Land use composition and configuration	Landsat Imagery / NASA [used to model services provided: soil quality, water quality etc]	Target basins / landscapes	Annually
Increased resilience of agro-ecosystems and communities, especially those including smallholders	Number of people affected by hazardous events	SDG Target Indicator 1.5. UNICEF data collection	National level aggregates in target countries	Annually
Reduced net GHG emissions from agriculture, forests and others forms of land use	* Net GHG emissions in the agriculture, forest and other land use (AFOLU) sector * Emissions of greenhouse gases in agriculture (per hectare of land and per unit of output, separately for rop and livestock sectors)	Primary data source include NSO's, UNFCCC, UNEP, WHO, and FAO/households level aggregates	National level aggregates in target countries	Periodic
Enhanced capacity to deal with climate extremes	# of countries which have formally communicated the establishment of integrated low-carbon, climate-resilient, disaster risk reduction development strategies (e.g. a national	SDG Target 13.2. Data captured by UNDP	National level in target countries	Periodic
Gender-equitable control of productive assets and resources	i) percentage with documented or recognized evidence gender-equitable of tenure; ii) percentage who perceive their rights are recognized and protected	SDG / SDSN Complementary National Indicator and UN Indicator	National level aggregates in target countries	Periodic
Conducive agricultural policy environment	Existance and adequate financing of policies that promote agricultural soil conservation practices	Assessment of national policies in target countries / WLE	National level in target countries	One-off and then follow-up as policies change in target countries

Table 2. Evaluation and impact assessment plan (for further details on rationale for each click here)

Review / Evaluation / Impact Evaluation / Impact Assesment+	Dates		Evaluation Focus*	Main Evaluation Topic/Issue	Geographic Focus		Description
	Start	End			Focus Country	Non-Focus Country	
Review / Evaluation	Feb-20	Oct-20	Wastewater	An assessment of how far WLE has influenced global thinking and guidelines on wastewater use in agriculture	Ghana, India	TBC	Qualitative causal tracing study
Joint review with the other global integrating CRPs	Oct-18	Feb-19	Intrative work of GI CRPs	Integrating tools and mechanisms	Global	TBD	Mid-term rapid assessment
Joint evaluation with the other global integrating CRPs	Mid-2022	End-2022	Intrative work of GI CRPs	Integrating tools and mechanisms	Global	TBD	Final evaluation
Evaluation	Feb-18	Oct-18	Water Management	Comprehensive Assessment of Water Management in Agriculture (CA), approximately 2003-2008	TBC	TBC	Ex-post evaluation
Evaluation	Feb-19	Oct-19	Regional Programs	Effectiveness of regional approach to achieving outcomes	Africa	Central Asia	Ex-post evaluation
Impact Evaluation	Feb-20	Dec-20	Water Policy Research	Determine the impact of the program on policies in India and lessons from implementation	India		Ex-post impact evaluation
Impact Evaluation	Oct-16	Dec-17	Water Use	The impact of Multiple Use Water Services (MUS) in Nepal to achieve SDG 6	Nepal		Ex-post impact evaluation
Impact Evaluation	Jun-16	Jul-17	Irrigation	Better Information for Better Irrigation System Governance	TBD		TBD
Impact Evaluation	Aug-16	Mar-18	Irrigation	Impact evaluation of improved irrigation and drainage management in the dry zone of Myanmar	n/a	Myanmar	TBD
Impact Evaluation	Dec-16	Mar-18	Solar Pumps	Impact evaluation of solar pumps on agricultural and environmental outcomes in Rajasthan, India	India		TBD
Impact Evaluation	Dec-16	Mar-18	Malaria	Agriculture and Malaria: The impact of environmental Management	Uganda		RCT
Impact Evaluation	Aug-16	Dec-17	Motor pumps	Impact of irrigation on agricutlural productivity, nutrition and health and women's empowerment	Ghana		RCT
Impact Evaluation	year 2017	year 2021	MESH Model	An assessment of the utilization of the MESH model in large scale restoration investments	Burkina Faso, Ghana, Ethiopia	Zambia	Qualitative causal tracing study
Impact Evaluation	year 202	year 2021	Seeds 4 Restoration Needs	An assessment of Seeds4Restoration Needs impact on mobilizing biodiversity for restoration actions.	Ethiopia		Ex post impact assessment
Impact Evaluation (early stage)	Mar-18	Feb-19	Land use practices	Evaluation of sustainable land uses on socioeconomic and environmental indicators for the household and landscape level.	n/a	Amazon basin countries	Ex post impact assessment
Project impact Assessment	Jan-17		Small-scale irrigation interventions	ILSSI / Africa Rising	Ethiopia, Ghana, Tanzania		Ex-post impact evaluation
Ex-Post Impact Assessment	Feb-19	Dec-19	AgWater Solutions Project	Determine the impact and generate new insights in water management investment opportunities in Africa and Asia	Tanzania, Ghana, Ethiopia, Burkina Faso, Zambia and India [selection to TBD]		Ex post impact assessment
Ex-Post Impact Assessment	Feb-21	Dec-21	Irrigation	Impact on performance and management of Asia's large-scale irrigation systems	Asia (countries TBD)		Ex post impact assessment

Table 3. CRP M&E & Impact Assessment Budget.[2]

M&E investments		AMOUNT BUDGETED						
		2017	2018	2019	2020	2021	2022	6-year Total
M&E	Subtotal:	**299,491**	**567,367**	**472,894**	**439,080**	**345,215**	**451,521**	**2,575,568**
Under the MSC budget	Amount:	299,491	317,367	322,894	339,080	345,215	351,521	1,975,568
Under the Competitive Grants Fund	Amount:	-	-	-	-	-	-	-
Under flagship budgets	Amount:	-	250,000	150,000	100,000	-	100,000	600,000
Impact assessment	Subtotal:	**1,390,000**	**840,000**	**640,000**	**850,000**	**790,000**	**850,000**	**5,360,000**
Under the MSC budget	Amount:	50,000	50,000	50,000	50,000	100,000	100,000	400,000
Under the Competitive Grants Fund	Amount:	-	-	-	-	-	-	-
Under flagship budgets	Amount:	1,340,000	790,000	590,000	800,000	690,000	750,000	4,960,000
TOTAL		**1,340,000**	**690,000**	**490,000**	**190,000**	**290,000**	**400,000**	**7,935,568**

M&E Costs Descriptions: Explanation of the definitions used by WLE for the types of costs/activities included under each category	Our CRP defines M&E to include: • Establishing and maintaining an online system for planning and reporting that includes activities, budget, deliverables and a performance indicator database • Establishing and monitoring CRP ToC and Flagship ToC, Strategy & Implementation Plans (e.g. milestones), Annual Plan of Work & Budget • Planning and implementing baseline studies • Establishing and maintaining our ToC evidence base • Change pathway monitoring External evaluations (CCEE, IEE, audits) are budgeted separately.
Under the MSC budget	Staff, M&E software system and its maintenance, baselines, indicator data collection, quality assurance
Under the Competitive Grants Mechanism	M&E system development and piloting
Under flagship budgets	Monitoring progress against annual plans of work and budgets, and bi-annual reporting
Impact assessment	Our CRP defines IA to include ex-ante impact assessment studies, adoption studies, *ex-post* impact assessment studies
Under the MSC budget	Staff to oversee planning and quality assurance
Under the Competitive Grants Mechanism	Commissioned CRP-level adoption studies, impact assessments
Under flagship budgets	Flagship-specific adoption studies, impact assessments

[2] Funding estimates include unsecured bilateral funding.

3.6 Linkages with Other CRPs and Site Integration

In collaboration with other integrating CRPs (ICRPS)[3], and with the Agri-Food System (AFS) CRPs, WLE works across multiples scales and sectors, and thereby helps identify synergies with other development sectors, potential leverage points, and ways to manage intended and unintended consequences of scaling out on wider ecosystems services. Details of the collaborative activities are presented here, and in Templates 3.6.1 and 3.6.2a. The collaboration with ICRPs is discussed first, followed by work with each of the AFS CRPs. WLE's main collaboration mode with other CRPs is to develop joint activities in key thematic areas and geographies, particularly the CGIAR target countries, and to undertake scoping studies and develop joint proposals to implement the research and scale up the results.

Also presented here are the progress and plans to date on WLE's engagement in the CGIAR target countries (see Template 3.6.2b). WLE prioritizes efforts in CGIAR target countries within the four WLE focal regions (Greater Mekong Region, the Ganges, and East and West Africa) to capitalize on established partner networks and uptake pathways. These include Burkina Faso, Ghana and Nigeria; Ethiopia, Uganda and Tanzania; Bangladesh, India and Nepal; and Vietnam.

3.6.1 Collaboration with Integrating CRPs

Agriculture for health and nutrition (A4HN)

The main mechanism of collaboration between WLE and A4NH is through the RUL Flagship Program (FP), specifically looking at opportunities within the circular economy as they relate to nutrition and health in agriculture. The focus is on areas of water and livestock waste by specifically: 1) assessing risks and risk mitigation options for water and food borne disease associated with vegetable farming in peri-urban areas in key locations (under RUL CoA 3.1); and 2) optimizing resource recovery (especially of energy) in livestock processing systems in East Africa for application in other locations (RUL CoA 3.2). The RUL Flagship will also use its networks and existing partnerships (WHO, FAO and UNEP) to support A4NH to achieve impacts in the domain of safe wastewater use and food safety. There are also important synergies being explored between RUL and A4NH in RUL CoA 3.1, in support of city region food systems, which CIAT will support in RUL and in the A4NH flagship on Food Systems.

Climate change (CCAFS)

The two integrating CRPs – WLE and CCAFS – have links with each other through several WLE FPs, including RDL, LWS and VCR. RDL and LWS collaborate with CCAFS on NRM practices that enhance adaptation and/ or reduce GHGs for testing in climate-smart villages; and to link with regional and national partnerships for climate change policy impact and scaling up climate smart agriculture interventions. The WLE VCR Flagship has very strong links with CCAFS, rooted in years of productive collaboration in Phase 1. Within the VCR itself, CoA 4.1 ("Managing Variability") has the strongest links - with CCAFS FPs 2 (Climate-smart agriculture practices and portfolios) and 4 (Climate information services and climate-informed safety nets). With the first, VCR will co-invest in developing and field testing large-scale landscape based solutions for water resources variability, and with the second, VCR will co-develop scalable interventions (e.g. drought monitoring, pro-poor flood insurance, etc.), that use climate and water – related information to manage climate-related risks. Most of the VCR collaboration with CCAFS will be in South and South-East Asia. LWS will continue collaborating with CCAFS in selected countries in sub-Saharan Africa. In LWS CoA 2.1,

[3] Acronyms and abbreviations are explained in Annex 3.14.

common topics of adoption and investments into climate smart agricultural land and water management (ALWM) solutions and practices for current and future variability will be addressed.

Policies and Institutions (PIM)

The CGIAR Research Program on Policies, Institutions, and Markets (PIM) focuses on implementable changes in the enabling environment for policies and institutions that will strengthen agri-food systems and increase returns to investments in technical innovation. PIM has many important linkages with WLE, especially PIM FP5 on Governance of Natural Resources that addresses the policy and institutional foundations for improved governance and management of natural resources. PIM FP 5 will work closely with LWS on institutions, land tenure and water rights and with the cross-cutting gender work. There are also linkages between VCR and PIM FP 1 on Technological Innovation and Sustainable Intensification, and with the Global Futures and Strategic Foresight Group activity. Here, VCR will provide insights on the role of water and energy to and the impacts of water variability on global food production and on constraints from competing water uses to food supply and demand. Moreover, RDL methodologies on land degradation assessment are being considered in PIM's FP 1; and WLE ESA's work on sustainability indexes and frameworks will also engage with PIM's FP 1. Recently, PIM and WLE's RUL FP have agreed to collaborate on rural-urban food systems ("Foodsheds").

3.6.2 Collaboration with Agri-Food System CRPs

As a natural resource based CRP with an integrating role, WLE provides the vehicle for integrated analysis of the outcomes and potential of CGIAR research across agro-ecosystems and specifically on rural livelihoods. Working in collaboration with the WLE flagships and relevant AFS CRP flagships, WLE's ESA Flagship will test the contribution to, and impacts on, sustainability of out-scaling of various crop and farming system interventions. Specific collaborations with RICE, FTA, DCL and Livestock[4] work to deliver two interlinked goals through the ESA CoAs: 1) to refine, test and benchmark AFS sustainability indicators at scale through jointly operationalized assessment tools; and 2) to support cross-discipline activities to provide decision-makers with a suite of tools to assess outcomes of alternate investment decisions, including evaluating trade-offs. The ESA and its partners will develop the capacity of scientists and government officials to use the assessment tools under various development scenarios. Specific examples of planned collaboration with AFS CRPs are given below. WLE's links to the AFS CRPs are largely but not exclusively focused through ESA. RUL, VCR, RDL and LWS also have specific links to AFS CRPs, as outlined below.

Dryland Cereals and Legumes (DCL)[5]

WLE through LWS, RDL and ESA will work closely with DCL Flagships 4 and 5 on solutions to the challenges of climate change, land degradation and complex human–ecosystem interactions as means to sustainably support livelihoods through better approaches to increase (or recover) land productivity. RDL and LWS will develop approaches for improved management of landscapes and irrigation systems, and will provide DCL with tools for *ex-ante* assessment of on-farm interventions at scale. Through work on integration sites, WLE-ESA and DCL collaboration will provide a foundation for accelerated uptake and testing of innovations at scale.

[4] ESA plans a sequential approach to work with the AFS CRPs. Collaboration with other AFS-CRPs will be developed as resources become available.

[5] We acknowledge that DCL, or L&DC as it is now called, is still under development and review but have continued to engage with its leadership. We will make adjustments later if necessary.

FISH

WLE's VCR Flagship is the primary vehicle of collaboration with FISH CRP. Both CRPs recognize the importance of water resources variability for inland and coastal fisheries. Floods, for example, bring significant benefits for both ecology and agriculture. The benefits associated with fisheries and agriculture in large inland floodplains, and deltaic systems, such as the Mekong Delta, may be an order of magnitude higher than annual costs of flood damages. Thus, management of variability and hydropower development needs to consider both avoiding or minimizing damages and optimizing the benefits. VCR will collaborate with the FISH CRP through its Flagship on Securing Small Scale Fisheries, particularly through its CoA on "Fish in Multifunctional Landscapes", to examine the trade-offs of protecting fisheries in different development options.

Forests, Trees and Agro-forestry (FTA)

Restoration of degraded agricultural lands and depleted forests is a large agenda with increasing international attention and support. FTA, as the agri-food system CRP focused on forests, trees and agroforestry, has a strong shared interest in this topic with WLE. The FTA flagship on landscapes works toward restoration of forest functions (ecosystem services) in support of livelihoods, and is complementary to WLE's RDL flagship that works to restore ecosystem services in agricultural landscapes. In addition, FTA provides knowledge on planting material for restoration through its flagship on tree genetic resources, and WLE provides an integrating framework to assess CGIAR-wide restoration work to which FTA will contribute. WLE and FTA will work closely together within the large regional framework for restoration – the 20by20 in Latin America – in Colombia and Peru, and plan to do the same within the AFR100 program for Africa as this initiative develops. Initiatives in Asia are under discussion. In addition, WLE's ESA Flagship will work with FTA's Landscapes and Livelihoods Flagship to provide quantification of the business cases for agroforestry interventions and assessment of impacts of out-scaling of FTA technologies. WLE has also been involved as a co-convener of the Global Landscape Forum that provides an important dialogue space for the CGIAR to collectively engage with outside partners.

Livestock

Two key areas of synergy have been identified between WLE and Livestock. The first is through the development of strategies, tools, models and indicators to support sustainable intensification, specifically between WLE's ESA flagship and Livestock Flagships on Livestock and Environment and Livestock Livelihoods and Agri-food Systems. The second area of collaboration will be between WLE's RDL and LWS, and Livestock to look at the restoration of degraded land and increasing land and water productivity in livestock systems (with the Livestock and Environment Flagship). While much of the focus of the systems research in the Livestock CRP is at the farm level, collaboration with WLE will create an opportunity to work at multiple scales and entry points to global fora.

Maize

WLE will work with MAIZE primarily through the RDL and VCR flagships. In both instances, collaboration involves sharing information and decision-analysis to improve the planning of maize cropping interventions in major bread-baskets in the developing world. In the RDL flagship, research is focused around decision-analysis to improve planning of agricultural development at the landscape level. In VCR, the focus is on identifying hotspots (competition, overdraft, pollution, energy variability) and 'sweet spots', where land, water and energy resources are conducive to sustainable intensification of relevant AFS CRPs including MAIZE.

RICE

Collaboration between RICE and WLE is essential in developing and promoting solutions to threats of water scarcity, flooding, and salinity to farmers' livelihoods, local and global food security, and other ecosystem services. The Global Rice Science Partnership (GRiSP) currently collaborates with WLE mainly through joint projects of the former Challenge Program on Water and Food (CPWF) in Bangladesh that were carried forward into the CRPs. Participating staff and selected activities are co-funded by GRiSP and WLE. Joint activities focus on the optimization of land and water resources at the field to landscape/polder levels in rice-based farming and aquaculture systems. Continued collaboration will largely be through "site integration" at common action sites/ geographies, such as in Asia's mega-deltas and coastal zones (in Bangladesh, Myanmar, and Vietnam). In these areas, the following opportunities for collaboration and/or co-investments are being explored:

- The RICE CoA 1, "Foresight and targeting", delineates and maps target domains for RICE technologies. Some of these have a specific "water dimension," such as drought-, salt-, or submergence-tolerant rice varieties and improving water and rice management practices. This FP will collaborate with WLE's VCR Flagship in the joint development of databases, tools, and methodologies. RICE has particular expertise, data, and partnerships in rice-based farming systems, whereas WLE has complementary expertise (such as hydrological modeling needed for foresight studies on water availability in rice-growing areas) and access to critical partnerships in the water domain that complement RICE's partnerships (e.g. irrigation or water resource ministries).
- RICE FP 3 will link with WLE's ESA and LWS CoA 2.2 to analyze and quantify the impacts of these solutions at larger spatial scales, such as irrigation systems or river deltas, and provides feedback for further improvement of such solutions by RICE FP 3.
- RICE FP 3 develops measures of biophysical and socioeconomic sustainability of rice-based cropping systems, including ecosystem services. WLE's activities on the sustainability framework in ESA will scale up (and provide feedback on) farm-level sustainability parameters from RICE FP3, and expand the ecosystem services of rice farms with landscape-level indicators.

Roots, Tubers and Bananas (RTB)

WLE and RTB will collaborate on specific flagship level activities, particularly through the RDL and RUL Flagships. The RDL flagship will support examining landscape level changes through predictive agronomy approaches at landscape/ national levels, based on spectral diagnostic and digital soil mapping methods for nutrient management of cassava in sub-Saharan Africa. The RUL Flagship and RTB will work on cassava waste generation and for turning cassava waste into an asset. RTB has significant technical expertise related to cassava waste which complements RUL's knowledge on business models for resource recovery from cassava waste.

Wheat

WLE will work with WHEAT primarily through the VCR flagship, with the aim of improving the planning of wheat cropping interventions in major bread-baskets of the world. This includes identifying hotspots (competition, overdraft, pollution, energy variability) and 'sweet spots', where land, water and energy resources are conducive to sustainable intensification of relevant AFSs.

Big Data Platform

The WLE ESA Flagship will collaborate with the CGIAR Big Data and ICT Platform. Three WLE partner centers (CIAT, IFPRI and IWMI) are leading/ confirmed partners in the platform; and the objectives of this initiative are closely aligned with research components of all of WLE's Flagships. ESA will link to the platform to provide support and guidance across the CRP for improved data generation, access, and management, and for opportunities to collaborate and convene around big data and agricultural development. This includes representing WLE science at the CGIAR Big Data Convention, and to learn how big data can support the CGIAR's Strategic Results Framework (SRF) and deliver development outcomes. WLE will also contribute to the development of the platform through the provision of relevant tools and data sets (particularly through the CoA on Information Systems in ESA, and flood monitoring under VCR CoA 4.1).

Template 3.6.1: Overview of Inter-CRP Collaboration: Provide and Receive

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
Integrating CRPs					
A4NH	**WLE provides:** Information in soil and crop micronutrient deficiencies at national scale and agro-input intervention options to address them. **WLE receives:** advice on integration of interventions into policy options	***WLE provides*:** Data, methodologies and research on ALWM and irrigation potential and food systems production capacity and resilience ***WLE receives*:** Data, methodologies and research on nutrition and wellbeing of ALWM and irrigation investment. **Locations:** West Africa	***WLE provides*:** Data, methodologies and research on business models for resource recovery in livestock processing systems; and health risk mitigation options. ***WLE receives*:** Data, methodologies and research on livestock processing value chains and possible health risks. **Locations:** Vietnam, East Africa		
CCAFS	**WLE provides:** Soil, water, land and biodiversity practices that enhance adaptation and/or reduce GHGs for testing in climate-smart villages; methods for estimating and measuring soil organic carbon	**WLE provides:** Insights on scaling and investment opportunities for agricultural land and water management (ALWM) as a climate resilient interventions		**WLE provides**: Insights on technologies, practices, policies, institutions and investments that enhance adaptation to climate change, e.g. data, methodologies and conceptual	

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
	Guidance on increasing soil carbon with permanence; improved understanding of biogeochemistry **WLE receives**: Support for implementation and approaches in climate-smart villages Tools and scenarios for identifying mitigation options that include soil carbon; framework for metrics, monitoring and GHG accounting issues. Linkages to global, continent-wide (e.g. NEPAD-led Alliance for CSA in Africa), regional and national partnerships for climate change policy impact and CSA scaling up	**WLE receives** Insights on complementary climate smart adaptation options **Locations:** West and East Africa, South Asia		development of large-scale underground solutions to floods and droughts under changing climates; e.g. experience and evidence on the application of flood-based index insurance, synergies with other flood and drought risk management interventions. **WLE receives:** Piloting of the above solutions in the field to demonstrate their proof of concept and upscaling Support implementation and approaches for climate-smart villages Methodologies and research on pro-poor farmers' flood insurance.	

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
				Locations: South and South- East Asia	
PIM		**WLE provides:** Data and knowledge on ALWM and irrigation development opportunities and scalability in systems intensification **WLE receives:** Knowledge and methods t**o** develop insights on local to national institutional solutions for PPP, land tenure and gender considerations **Locations:** West and East Africa, South Asia	**WLE provides**: Data on urban food demands and locations of food supply; technical solutions for addressing food waste at different scales. **WLE receives**: CGE modeling support to analyze how urban (consumer) demands affect changes in smallholder farming in different African locations; and how government interventions, including reducing urban food waste, might alter those linkages and scenarios. **Locations:** Ghana, Ethiopia, Uganda, Burkina Faso	**WLE provides:** Insights on the role of water to and the impacts of water variability on global food production and on constraints from competing water uses to food supply and demand. Insights of impacts of fertilizer use on agricultural water pollution **WLE receives:** Results from global food projections modelling to assess impacts on future water demands and security	**WLE provides:** Research data decision support and analytics linked to the uptake of sustainability framework and indices **WLE receives:** data and methodologies on regional and global crop and livelihoods models

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
Agri-Food System CRPs					
DCL	**WLE provides**: Integrating framework for restoration assessment and monitoring Projections on land degradation risks and potential impact of preventive and restorative intervention strategies Assessment of impact of soil, water and biodiversity interventions for restoration potential in landscapes **WLE receives:** Information on drivers and economics of dryland degradation and costs and benefits of restorative interventions Provision of dryland cropping materials for restoration schemes	**WLE provides:** Research and tools for land and water allocation at basin and irrigation systems scale; and assessing social ecological opportunities and impacts of on-farm capture, storage and utilization of water and nutrient resources for target DCL crops and landscapes **WLE receives:** Research, data, tools and farming system natural resource requirements for DCLA legumes and cereals from farm /field scale **Locations:** West and East Africa, South Asia, MENA			**WLE provides:** Targeting and valuation tools that facilitate quantification of the positive and negative externalities of agricultural intensification when scaled **WLE receives:** Research data and methodologies on sustainable management practices at the farm level and local and regional partnerships

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
Fish				**WLE provides** Data, tools and research on flooding pattern in major deltas and floodplains to evaluate the role of water variability on inland fisheries Analysis of Hydropower –Fisheries trade-offs in selected river basins **WLE receives:** Quantified benefits associated with inland fisheries and recession agriculture. **Locations** – Mekong, Zambia, Bangladesh	
FTA	**WLE provides:** Integrating framework for restoration assessment and monitoring Assessment of impact of soil, water and biodiversity interventions for restoration potential in landscapes **WLE receives:** Input to the above on forest restoration,			**WLE provides:** Data, methodologies and conceptual development of interactions of water with terrestrial land use, including forest systems; e.g. on large-scale underground solutions to floods and droughts through	**WLE provides:** Targeting and valuation tools that facilitate quantification of the positive and negative impacts of agricultural intensification when scaled **WLE receives:** Research data and methodologies on sustainable forest

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
	peatlands and ex- mining forest restoration Knowledge on planting material for large scale restoration schemes, research findings on potential of tree species to contribute to provision of ecosystem services including building soil carbon and health Data from sentinel landscapes			managed aquifer recharge **WLE receives**: Input to the above solutions from forestry and tree cover management, including terrestrial rainfall recycling	management and agro-forestry practices and local and regional partnerships; Decision and scaling contexts that WLE's tools can be applied in, and linkages to, FTA's negotiation support methodologies
Livestock	**WLE provides: I**ntegrating framework for restoration assessment and monitoring. Assessment of impact of soil, water and biodiversity interventions for restoration potential in landscapes **WLE receives:** Input to the above on livestock systems. Provision of forage material for restoration schemes, research findings on potential of forage grasses to	***WLE provides*:** Data, methodologies and research on options for ALWM, water supply and irrigation opportunities in livestock value chains across landscapes under mixed sustainable intensification ***WLE receives*:** Data, methodologies and research on livestock products and	***WLE provides*:** Research data on business models and risks related to wastewater use for fodder production and energy recovery from slaughterhouse waste ***WLE receives*:** Research data on livestock processing systems and quantitative material flows. **Locations:** East Africa	**WLE provides: A**ssessment of the best water storage portfolios that help adapt water resources variability (e.g. droughts) **WLE receives:** Data and methodologies on incorporation of livestock needs into integrated storage-livestock solutions that help alleviate water	**WLE provides:** Targeting and valuation tools that facilitate quantification of the positive and negative externalities of agricultural intensification when scaled **WLE receives:** Research data and methodologies on sustainable management practices at the farm level and local and regional partnerships

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
	contribute to soil carbon and soil health	fodder value chains and possible farm-field environmental footprints **Locations:** East Africa; West Africa		resources variability impacts **Locations:** West Africa	
Maize	**WLE provides:** Soil and plant nutrient analytical methods, digital mapping of soil constraints, and risk-based landscape-wide approaches to predictive agronomy **WLE receives:** Best practices and cost-benefit information for maize production for integration into design of integrated landscape interventions	**WLE provides:** Assessment of landscape scale impacts of alternate water management practices for maize cultivation **WLE receives:** Information on water regime impacts on maize varieties. **Locations:** East and West Africa, and South Asia		**WLE provides:** Data and information on the pattern of variability in major Maize producing Areas; assessment and testing of agricultural and non-agricultural solutions to growing trade-offs across competing resources uses that may affect sustainable intensification of maize in these areas **WLE receives:** Information on flood, drought, heat-tolerant varieties of maize **Locations:** key maize producing areas of the world to assess and test	

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
RICE		**WLE provides**: Assessment of irrigation system scale impacts of alternate water management practices for Rice cultivation **WLE receives:** Information on water regime impacts on Rice varieties **Locations:** Asia		**WLE provides:** Data and information on the pattern of variability in major rice producing Areas; assessment and testing of agricultural and non-agricultural solutions to growing trade-offs across competing resources uses that may affect sustainable intensification of rice in these areas **WLE receives:** Information on flood, drought, heat, salinity and submergence tolerant varieties of rice **Locations:** SA and SEA	**WLE provides:** Targeting and valuation tools that facilitate quantification of the positive and negative externalities of agricultural intensification when scaled **WLE receives:** Research data and methodologies on sustainable management practices at the farm level and local and regional partnerships
RTB	**WLE provides:** Soil and plant nutrient analytical methods, digital mapping of soil constraints, and risk-based landscape-wide approaches to predictive agronomy **WLE receives:** Best practices and cost-benefit information		***WLE provides*:** Research data and business models for resource recovery from cassava waste ***WLE receives*:** Quantitative assessments of cassava		

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
	for RTB production for integration into design of integrated landscape interventions.		waste generation and value chain economics **Locations:** West Africa		
Wheat		**WLE provides:** Assessment of landscape scale impacts of alternate water management practices for wheat cultivation. **WLE receives:** Information on water regime impacts on wheat varieties. **Locations:** East and West Africa, and South Asia.		**WLE provides:** Data and information on the pattern of variability in major Wheat producing Areas; assessment and testing of agricultural and non-agricultural solutions to growing trade-offs across competing resources uses that may affect sustainable intensification of wheat in these areas **WLE receives:** Information on flood, drought and heat-stress tolerant varieties of Wheat **Locations:** key wheat producing areas of the world	

	CRP: Water Land & Ecosystems				
Flagship	**RDL**	**LWS**	**RUL**	**VCR**	**ESA**
	Restoring Degraded Landscapes	**Land & Water Solutions**	**Sustaining Rural-Urban Linkages**	**Managing Variability, Risk & Competing Uses**	**Enhancing Sustainability Across Agricultural Systems**
Big Data platform	**WLE provides:** Data science methods and databases on land/soil assessment and restoration in landscapes **WLE receives:** Platforms for data integration	**WLE provides**: Access to research and operational data generated through field research **WLE receives:** Access to knowledge on big data management, analysis and dissemination techniques			**WLE provides:** Access to relevant big data sources and coordination, organization, and cataloguing the use of big data across the program **WLE receives:** Access to big data sources across the portfolio

Template 3.6.2a: Partnerships with other CRPs (activities, mode, geographies and outcomes sought)

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
Integrating CRPs					
A4NH	Assessing risks and risk mitigation options for water and food borne disease associated with vegetable farming in peri-urban Vietnam and East Africa; assessing micronutrient constraints in African soils and food crops; and optimizing resource recovery in livestock processing systems in East Africa for application elsewhere	Provide data, methodologies and research on business models for resource recovery in livestock processing systems; provide data on soil and crop micronutrient status in Africa and appropriate ways to mitigate impacts; and on health risk mitigation options	Provide data, methodologies and research on livestock processing value chains and possible health risks; policy advocacy on soil-crop micronutrient interventions in Africa	Joint research (to be explored)	Models for safe livestock value chains with resource recovery from waste; resulting in business models for transfer elsewhere. Vietnam, Kenya, Ethiopia, Uganda; intervention options for improving soil-plant-livestock-human nutrition in Africa
CCAFS	Incorporation of soil carbon sequestration opportunities into national priorities and investments Joint analysis of decisions related to incorporation of soil carbon in MRV systems Estimation of impacts of climate smart agriculture and other land use and management practices on soil organic carbon and GHG emissions, with focus on sub-Saharan Africa	Development of climate smart technologies for building soil carbon in agricultural landscapes, biogeochemistry c soil carbon and recommendations for implementation pathways	Incorporating WLE technologies into a broade climate-smart perspective (see above) National to global engagement (see above) Integration of soil C in too and scenarios Developing readiness and program planning for climate finance Tools and scenarios for identifying mitigation options that include soil carbon; framework for metrics, monitoring and GHG accounting issues	Joint (ongoing) in Kenya; (if new resources are obtained) in Vietnam Nepal, Uganda, Ghana, Senegal, Tanzania, Colombia	Readiness for climate financing coupled with location specific portfolios of climate relevant practices to increase soil carbon sequestration (inclusion of soil carbon in NDCs)

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
	Incorporation of climate-smart technologies into Climate smart villages (CSVs) in Laos	Development of climate-smart technologies (e.g. rainwater harvesting, land-use management); integrating Climate Smart Agriculture (CSA) recommendations in technology guidance for upscaling	Incorporating WLE technologies into a broader climate-smart perspective National to global engagement Integration of soil C in tools and scenarios	Joint research	Prioritized portfolios of CSA interventions in agricultural systems in different agro-ecologies; Laos and larger GMS
	Managing flood waters for drought alleviation through managed aquifer recharge in India and Bangladesh	Development of landscape based underground technologies to deal with flooding (WLE VCR)	Pilot testing with stakeholders of underground storage of flood water for irrigation/drought management Policy and institutional mechanisms for scaling out	Joint research and co-investment (on-going	Evidence and guidelines for management of flood water for drought mitigation and irrigation. India, Bangladesh, Sri Lanka, with possibilities in Myanmar, China
	Advancing index-based flood insurance in India and Bangladesh	Appropriate hydrological monitoring (WLE VCR)	Downscaled weather data for use in index-based flood insurance Flood index product development Institutional approaches to flood insurance	Joint research and possible co-investment	Index-based flood insurance that incentivizes the adoption of CSA (with other CRPs) Global synthesis of opportunities and challenges for index-based insurance India, Bangladesh, Nepal, with possibilities in sub-Saharan Africa (e.g. Nigeria)

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
PIM	Joint research on addressing surface and ground water quantity, quality and variability constraints for the Global Futures/Strategic Foresight program of CGIAR	Data, modeling, case studies, joint publications	Data, modeling, joint publications	Joint research	Prioritized insights on breadbaskets at risk from growing water pollution, water variability and water scarcity. (South Asia and West Africa)
PIM	Research on land tenure and water rights in Sub-Saharan Africa as barrier for men and women access to agricultural land and water management solutions (ALWM) Models and modalities of public-private partnership in medium and large-scale irrigation development, both new and revitalized Role of water user associations in agro-ecological landscapes under transformative sustainable intensification processes	LWS researches issues of access to land and water. LWS contributes findings on the management of shared landscapes to build a knowledge repository, through which LWS can both share and draw from evidence-based tools, methods, impact assessments and institutional solutions Through LWS CoA 2 "Revitalizing irrigation" the context for needed solutions on PPP is provided	Models, methods and data on household agricultural water management impacts on male and female headed households. Provision of methods to identify local institutional solutions on land and water rights and access; approaches in gender sensitive development in ALWM Analysis of impacts of land tenure on farming systems and individual investment strategies Analysis of context specific PPP models for irrigation sector investment	Joint research, collaborating on developing joint platforms	Guidance on impacts of policy and institutional arrangements on performance of rainfed and irrigated agricultural systems at landscape scale Ghana, Ethiopia, India, and other West, East Africa and South Asia countries depending on bilateral sources.
AFS CRPs					
DCL	Assessing impacts of alternate DCL cropping systems (including field agronomy) on natural resources and ecosystem services at irrigation	Provide research and tools for land and water allocation; and assessing impacts of on-farm water	Technologies for improved water use efficiency in cropping systems. Interactions of	Combination of joint research in shared locations and application of	Improved knowledge of impacts at-scale of DCL

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
	system and landscape scale in India, Pakistan Joint assessment of land degradation risks in drylands, as input to a global assessment of land degradation risks and preventive and restorative intervention strategies, including uncertainty, initially in sub-Saharan Africa	and nutrient management innovations	cropping systems and land and water management practices. Provides estimates of the value of land and land degradation/restoration	jointly developed analysis tools and indicators	developed on-farm management systems
Fish	Joint research on the impacts of hydropower development and water resources variability management – on inland and coastal fisheries – in Mekong Basin, Ganges / Brahmaputra deltaic areas of Bangladesh	Provision of data and advise on the impacts of hydropower, other water infrastructure development, and overall basin-wide water resources variability management – on hydrological aspects (e.g. inundation) that are of critical importance to capture fisheries	Quantification of benefits associated with inland fisheries as induces by seasonal flooding	Joint research on the impacts of hydropower development and water resources variability management – on inland and coastal fisheries.	Provision of data and advice on the impacts of hydropower, other water infrastructure development, and overall basin-wide water resources variability management – on hydrological aspects (e.g. inundation) that are of critical importance to capture fisheries. Mekong basin and Bangladesh
FTA	Design of restorative options in Ethiopia, Peru, Colombia	Design of agricultural system based restorative options	Design of tree-based restorative options	Joint research and application of jointly developed analysis tools and indicators	Viable restorative solutions. Ethiopia, Peru and Colombia
FTA	Research on long-term impact of various system interventions on soil health, associated food system resilience, and adaptation to climate change	Incorporate information on intervention impacts on soil health into risk-return models to guide investment decisions	Provide data on long-term impact of various system interventions on soil health, associated food system resilience,	Joint research	Ethiopia, Kenya, Tanzania, Peru Soil health impacts incorporated into risk-

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
			and adaptation to climate change		return models of intervention options
FTA	Engagement in dialogues at regional and global levels on landscape restoration	Engagement, dialogues and science	Evidenced-based advocacy on potential of tree-based restorative options	Joint presentations	Land Degradation Assessment of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES), the Convention on Biological Diversity (CBD) and its Aichi Targets, the Global Partnership on Forest Landscape Restoration (GPFLR), the Global Soil Forum, the Economics of Land Degradation Initiative (ELD), the UNCCD, and the UNFCCC
FTA	Focus on impact analysis for and spatial targeting of tree and forest based intervention for decisions on large landscape scale investment options. Development of Indicators framework to assess of trade-offs and synergies across sectors and levels to enable stakeholders to compare, from field to landscape level, the impacts of investments in AFS and related agricultural land and water management scenarios	Provides targeting and valuation tools that facilitate quantification of the positive and negative impacts of agroforestry and forest restoration activities when scaled	Provides research data and methodologies on sustainable forest and agroforestry management practices and the specific measures of agricultural and environmental externalities of these measures. Convenes and avails its partner networks of decision-makers and experts for participatory	Joint research in shared research sites	Joint analysis of tree based AFS externalities with UNEP TEEB, integration of forest and agroforest based interventions in large landscapes scale interventions in Ghana, Burkina Faso, Tanzania, Ethiopia and Vietnam

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
			decision analysis processes		
Livestock	Assessing opportunities and impacts of water and biomass appropriation in livestock value chains at landscape scales in East (Ethiopia, Tanzania) and West (Burkina Faso, Ghana, Niger) Africa Assessment of rangeland degradation and Input to global assessment of livestock as a driver of land degradation, with initial focus on East Africa (Ethiopia, Kenya, Tanzania) Development of strategies, tools and models to support the sustainable resilient intensification of major food systems. Identifying key attributes and monitoring indicators of sustainable intensification and resilience in different food production systems across scales East (Ethiopia, Tanzania) and West (Burkina Faso, Ghana, Niger) Africa	Provide data, methods and approaches for scaling water and land appropriation in crop- livestock production systems, and design advice for policy and investments for pro-livestock development pathways	Provide data, methodologies and analyses on ALWM, water and biomass appropriation and opportunities in livestock production value chains for investment options in policy and development	Joint research and fund raising in partnership with boundary partners (on-going)	Integrated livestock-crop landscape options and solutions for ALWM out-scaling for smallholder dominated agro-ecological landscapes in Ethiopia, Tanzania, Kenya, Ghana, Burkina Faso and Niger
Maize	Development of predictive agronomy approaches at landscape/national level based on spectral diagnostic and digital soil mapping methods for nutrient management of maize in sub-Saharan Africa	Scientific and technical advisory services and analytical services in use of low cost, high throughput soil and plant spectral analytical methods and available digital mapping products for developing evidence-based approaches	MAIZE scientists are conducting multi-locational trials on maize agronomy and will conduct soil and plant sampling	Advisory services, soil-plant analytical services, joint data analysis	Development of generalizable predictive relationships on response on cassava to soil variability and nutrient inputs in Africa and Asia. Countries include Nigeria, Tanzania, India, Nepal; others to be decided

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
		to predicting agronomic responses to nutrient inputs considering landscape variability			
Maize	Eastern Gangetic Plain (India and Bangladesh to identify hotspots (competition, overdraft, pollution, energy variability) and 'sweet spots', where land, water and energy resources are conducive to sustainable intensification of maize	The provision of detailed information on the duration, timing and extent of annual inundation or drought extremity – to match with different levels of crop tolerance; quantifying and addressing natural resource constraints and potential (e.g. water quantity, water quality, environmental flows and groundwater)	Provision of information on flood, drought, heat-tolerant varieties of maize	Complementary research	India, Bangladesh; other major maize- producing areas
RICE	Assessing irrigation system impacts of alternate rice agronomic practices in selected ecosystems in Asia	Provide systems scale analysis tools and approaches	Provide data and methods	Joint research	Guidelines for upscaling revised field irrigation regimes with recommendations for irrigation system performance criteria Viet Nam, Myanmar
RICE	Sustainable intensification of land and water solutions/rice-based farming systems. Geography: major Asian river deltas in Myanmar, India, Bangladesh, Vietnam	Through WLE flagships ESA, LWS and VCR, develop landscape level sustainable farming solutions and enhance ecosystem services; analyze and quantify the impacts of the RICE solutions at larger spatial scales, such as irrigation systems or river	Develop sustainable rice management technologies and rice-based farming systems; quantify biophysical, environmental and socio-economic sustainability parameters for rice	Complementary research	Sustainable intensification solutions in rice-based farming systems at multiple scales. Myanmar, India, Bangladesh, Vietnam

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
		deltas, and provides feedback for further improvement of such solutions by RICE; scale up (and provide feedback on) farm-level sustainability parameters from RICE FP3, and expand the ecosystem services of rice farms with landscape-level indicators			
RTB	Landscape restoration (Development of predictive agronomy approaches at landscape/national level based on spectral diagnostic and digital soil mapping methods for nutrient management of cassava in sub-Saharan Africa) RTB are conducting multi-locational trials on cassava agronomy and will conduct soil and plant sampling, SE Asia (FP3, FP5)	Scientific and technical advisory services and analytical services in use of low cost, high throughput soil and plant spectral analytical methods and available digital mapping products for developing evidence-based approaches to predicting agronomic responses to nutrient inputs considering landscape variability	Advisory services, soil-plant analytical services, joint data analysis	Development of generalizable predictive relationships on response on cassava to soil variability and nutrient inputs contributing to integration of agronomic practices into landscape context	Landscape restoration (Development of predictive agronomy approaches at landscape/national level based on spectral diagnostic and digital soil mapping methods for nutrient management of cassava in sub-Saharan Africa). Countries in Africa to be decided upon. South East Asia Vietnam, Thailand
RTB	Development of predictive agronomy approaches at landscape/national level based on spectral diagnostic and digital soil mapping methods for nutrient management of cassava in sub-Saharan Africa	Scientific and technical advisory services and analytical services in use of low cost, high throughput soil and plant spectral analytical methods and available digital mapping products for developing evidence-based approaches to predicting agronomic	RTB are conducting multi-locational trials on cassava agronomy and will conduct soil and plant sampling	Advisory services, soil-plant analytical services, joint data analysis	Development of generalizable predictive relationships on response on cassava to soil variability and nutrient inputs in Africa. Countries to be decided

Partner CRP	ACTIVITY [COUNTRY(IES) IN WHICH THIS TAKES PLACE]	WLE ROLE	COLLABORATING CRP ROLE	COLLABORATION MODE	OUTPUT; ADDED VALUE; TARGET COUNTRIES
		responses to nutrient inputs considering landscape variability			
WHEAT	Eastern Gangetic Plain (India and Bangladesh to identify hotspots (competition, overdraft, pollution, energy variability) and 'sweet spots', where land, water and energy resources are conducive to sustainable intensification of wheat	The provision of detailed information on the duration, timing and extent of annual inundation or drought extremity – to match with different levels of crop tolerance; quantifying and addressing natural resource constraints and potential (e.g. water quantity, water quality, environmental flows and groundwater)	Provision of information on flood, drought, heat-tolerant varieties of wheat.	Complementary research	India Bangladesh; other major wheat-producing areas

Template 3.6.2b: Plans for Site Integration in CGIAR Target Countries

Target country (++ and + countries relevant to WLE)	Steps taken so far (March 2016) to establish national level engagement with other CRPs towards site integration	Plan and schedule through which WLE will provide relevant elements for development of CGIAR site integration in this country
Bangladesh	WLE through its partnership with World Fish and CPWF has been actively involved on the CGIAR Advisory Committee. Through this venue all CGIAR centers plus AVRDC and IFDC meet with our NARS and Ministry officials twice a year. We have met twice in 2015 and will meet 2 times in 2016. All details for this integration as well as 4 CAC minutes are posted on the http://gcard3.cgiar.org/national-consultations/bangladesh/.	In Bangladesh, WLE will follow the 5-year Country Investment Plan and BARC 10-year research plan which we jointly established. Most research agendas are clearly defined within these 2 documents. WLE, through WorldFish, is engaged in supporting the development of the site integration plan.
Burkina Faso	WLE has been part of a process since 2013 to establish better integration. This includes a series of meetings that were held since June 2013 to improve coordination, planning and alignment to Burkina Faso's development plans and priorities. Main CRPs involved include: Drylands, CCAFS, FTA and WLE. Staff from multiple centers working in the Volta Basin have provided direct research support to the Volta Basin Strategic Action Program which builds on contributions made by CPWF. The VBA serves as the multi-stakeholder and multi-agency body to coordination across ministries. The Volta Basin Observatory is being developed as the primary repository for landscape biological, and sociological information for decision support targeting interventions. Overall, the CRPS' joint initiative in Burkina Faso has set up and followed until now a participatory approach involving CGIAR actors (CRPs and Centers), national actors of Burkina Faso, and other international actors intervening in Burkina Faso, to frame partnership, map research interventions and define development and research priorities to be considered for the rural development of Burkina Faso.	WLE through the joint efforts of ESA and RDL provides direct support to World Bank funded ecosystem service based interventions that support increased agricultural productivity and resilience. We use the VBA as the coordinating multi-agency and transboundary data collection, analysis and use. WLE has contributed to the development of a joint project site for joint activities of the Centers and CRPs in Burkina Faso.
Ethiopia	The Ethiopia CGIAR country collaboration and site integration process is coordinated by a committee representing 11 CGIAR Centers (Bioversity, CIAT, CIFOR, CIMMYT, CIP,	One of the recommendations suggested by the stakeholders was that CGIAR activities better align with

Target country (++ and + countries relevant to WLE)	Steps taken so far (March 2016) to establish national level engagement with other CRPs towards site integration	Plan and schedule through which WLE will provide relevant elements for development of CGIAR site integration in this country
	ICARDA, ICRAF, ICRISAT, IFPRI, ILRI and IWMI) that are based in Ethiopia, plus 3 others (Africa Rice, IITA and IRRI) who have no offices in the country, 10 CRP focal points, (Climate Change, DCL, Forest and Agro Forests, Livestock, Maize, Nutrition and Health, PIM, Rice, Roots Tubers & Bananas and WLE), and the Genebank platform. This is the larger group that receives all communications on this process and meets quarterly. On 11 December 2015, a CGIAR national consultation was held focused on strengthening mechanisms of engagement and seeking ways to better align to national priorities. One of the key recommendations was the need to establish a joint CGIAR-national agriculture research system collaboration and communication mechanism. It has been recommended to establish a permanent secretariat for joint planning, sharing of findings, and monitoring and evaluation.	the national Growth and Transformation Plan II (GTP 2015-2020). ILRI led a small group in articulating how this can happen. A group led by ILRI is also working on country plans to feed into the next round of the CRPs by 31 March 2016. WLE is engaged in supporting the development of the site integration plan.
Ghana	In Ghana, a 12-member Steering Committee (SC) made up of representatives of Centers /CRPs has been established in January 2016. Several meetings were held to plan for the national consultation workshop held from 2-3 March 2016 and led by IWMI and WLE.	The site integration /national consultative process is being led by IWMI/WLE. CGIAR has defined thematic focus with national stakeholders during the workshop in March. Next steps are: 1) finalize the site integration plan with the information gathered during the workshop; 2) engage in regular consultation and exchange with the national partners through their representation in the steering committee and 3) sharing information at national platforms. The SC agreed that sharing of information, as well as collaboration in joint activities and resource mobilization is paramount to strengthen our integration. Collaboration will commence on the identified themes and with a joint visit to the National Development Planning Commission of Ghana.

Target country (++ and + countries relevant to WLE)	Steps taken so far (March 2016) to establish national level engagement with other CRPs towards site integration	Plan and schedule through which WLE will provide relevant elements for development of CGIAR site integration in this country
India	A steering committee was formed in January 2016 comprising representatives from CG Centers (12) and CRPs present in India. A 17-member steering committee (led by ICRISAT) has met twice since January 2016, to discuss the site integration activities and plan for the stakeholder consultation workshop (national) to be held on 22nd March 2016.	Prepare for the National Consultative Workshop jointly with other CG Centers and CRPs: the following activities to be undertaken in preparation for the consultative workshop: 1) Prepare a list of projects carried out in India. 2) Prepare a country report of projects/activities undertaken by CRPs/ Centers. 3) Map the relevant projects into an India map that delineates 5 ecological zones: Coastal, Hills, Arid, Rainfed, Irrigated. 4) Prepare presentations on past projects and phase II proposal. Also, meet with the newly appointed DG of the ICAR (Indian Council of Agriculture Research) to get strategic direction for the stakeholder workshop. ICAR is the apex body in the country that coordinates activities related to agriculture.
Nepal	The process of site integration in Nepal was initiated on November 9, 2015 by organizing a meeting of all CG centers working in Nepal. The site integration steering committee was formed (with one member from each CG/CRP centers) including CIMMYT, IWMI, Bioversity, IFPRI, IRRI, CIFOR and ICARDA. CCAFS was included in the subsequent meeting. Two meetings were held on 4th and 30th December 2015 to share information on work being done by each center in Nepal and to plan for a stakeholder consultation meeting. The stakeholder meeting was held in Kathmandu in January 2016. The objectives were to consolidate CG center agendas and improve collaboration and alignment with partners in line with national priorities and policies. More than 60 participants, representing 34 national institutions participated. The cost of this meeting was shared by all centers. For more info, see https://library.cgiar.org/handle/10947/4148	IWMI/WLE is one of the co-leaders of the Nepal Steering Committee and helped organize the consultation meeting. The next steering committee meeting has been scheduled for 10th March to draft the site integration. This is being done based on the national consultation and experiences of each of the centers in Nepal. The central point will be the Agriculture Development Strategy (ADS 2015-2035) approved by Government of Nepal on 14th August, 2015. WLE will continue to work on integration through the SC.

Target country (++ and + countries relevant to WLE)	Steps taken so far (March 2016) to establish national level engagement with other CRPs towards site integration	Plan and schedule through which WLE will provide relevant elements for development of CGIAR site integration in this country
Nigeria	WLE is part of the process group for site integration in Nigeria. A national stakeholders' consultation workshop was held in Nov 2015 focused on: understanding Nigeria's agricultural research and development strategy; mapping the CGIAR activities and sites in the country; developing a common understanding of integration and key principles to be considered; identifying the roles of various stakeholders in the integration process and; developing a framework for integration. Integration will start with on-going multi-CRP/Center projects that build on synergies of on-going major initiatives such as the agricultural transformation agenda for productivity and sustainability, agro enterprise processing zones and other mega-initiatives in Nigeria.	WLE is part of the ongoing integration process especially the joint development of the new CGIAR-FARA-African Development Bank (AfDB) Africa-wide initiative on FEEDING AFRICA. This potential project known as Technologies for African Agricultural Transformation (TAAT), will implement the scaling up and out of the proven technologies from the CG-centers in Nigeria and 19 other countries. From 11-15 April, WLE joined other CRPs/Centers at a regional consultative workshop in IITA to further develop the TAAT project proposal.
Tanzania	The Tanzania CGIAR country collaboration and site integration process is coordinated by a CG- Tanzania Site integration process group composed of representatives from: The Ministry of Agriculture , Livestock and Fisheries (3 persons); Private Sector (1); 7 CGIAR Centers (CIAT, CIP, ICRAF, IITA, IRRI, Africa Rice, and ILRI) that are based in Tanzania plus 4 others (Africa Rice, ICRISAT, CIMMYT, Bioversity International) who have no offices in the country; 9 CRP focal points, (Climate Change, Livestock, Maize, Nutrition and Health, PIM, Rice, Roots Tubers & Bananas, WLE); and the Genebank platform. WLE participated in a Tanzania national site integration and consultation workshop convened by IITA in Dares Salaam on 3-4 December 2015.	WLE participated in a Tanzania national site integration and consultation workshop convened by IITA in Dares Salaam on 3-4 December 2015. The workshop brought together representatives of the CGIAR centers, CRPs working in Tanzania and their key partners/stakeholders in the agriculture sector, to deliberate on how they can better work together and how the CGIAR/CRPs can better align their activities and research agenda to the country's priorities as well as other on-going private sector initiatives including in-country donor priorities. About 60 participants were in attendance.
Uganda	The site integration process in Uganda is jointly chaired by Bioversity and CIP on a 2-year rotational basis, with Bioversity starting in 2016. A steering committee involving all the 8 CGIAR centers present in Uganda (Bioversity, CIAT, CIP, ICRAF, IFPRI, IITA, ILRI, and IWMI), was formed and held its first meeting on January 27, 2016. At that	Based on the national consultation, a 10 step process is being developed and will be submitted to the CO. WLE is engaged in supporting the development of the site integration plan.

Target country (++ and + countries relevant to WLE)	Steps taken so far (March 2016) to establish national level engagement with other CRPs towards site integration	Plan and schedule through which WLE will provide relevant elements for development of CGIAR site integration in this country
	meeting the 1st Consultation Stakeholder meeting was fixed for 9 March 2016. All centers agreed to share the costs of the stakeholder consultation workshop. A second Steering Committee meeting was held on 11 February 2016, following which the chair and co-chair visited some key NARS stakeholders such NARO-Uganda DG and Makerere University. The CIAT member consulted with the Uganda National Farmers' Federation, while the IWMI member consulted with teams in the Ministry of Finance. These consultations helped to collect secondary data and afforded us opportunities to interact with key stakeholders. The 3rd Steering Committee meeting was held on February 29, 2016 and focused on the plans for implementing the Stakeholder Consultation workshop. A national consultation was held on March 9, 2016 which helped better understand how CGIAR research can align to the priorities of the government. Action points for improving coordination were also discussed.	WLE has a small but growing presence in Uganda, with 13 projects under phase I active in the country, supported by IWMI's Regional Office based in Ethiopia, and the WLE Performance & Evaluation Manager, who is based in Uganda. The P&E Manager has been leading IWMI/ WLE's involvement in the 8 CGIAR Center Uganda Country Integration Committee. There are plans to expand operations during Phase 2.
Vietnam	Nine CRPS and 10 Centers have participated in the Vietnam planning for CGIAR country coordination. A first coordination meeting was held at the request of the Ministry of Agriculture and Rural Development in November 2015. A national stakeholders' consultation workshop was organized in December 2015, with over 70 participants representing: 1) research institutes and government agencies, 2) universities, 3) NGOs-private sector agencies and associations, 4) international organizations and donors, and 5) CGIAR staff. Between December 2015 and March 2016, CRPs/Centers also engaged in bilateral discussions on specific collaboration needs and opportunities. Several CRPs also organized their respective country/regional planning and consultation events. IWMI-WLE representatives attended the 1st MARD-CGIAR Coordination Meeting in November 2015 and the Vietnam Stakeholder's wider consultation on December 14-15. In addition, WLE's Vietnamese partners participated in the WLE-Mekong Forum on Water, Food and Energy in October 2015.	WLE works in six of the eight ecological zones identified for collaboration. Collaborative work was identified as irrigation of coffee and other upland crops in the Northwest; integrated water resources management for multi-purposes (hydropower, irrigation) in the Red River Delta; groundwater management for coffee and other crops in the Central Highlands; water sharing and transboundary watershed management in the South Central Coast and Southeast; and water management for rice and fish under climate change, sea level rise and infrastructure development in the Mekong River Delta. WLE is engaged in supporting the development of the site integration plan.

Target country (++ and + countries relevant to WLE)	Steps taken so far (March 2016) to establish national level engagement with other CRPs towards site integration	Plan and schedule through which WLE will provide relevant elements for development of CGIAR site integration in this country
	The country collaboration/site integration efforts in Vietnam is coordinated through: 1) core team with representatives from CRPs/Centers having physical (office) presence in Vietnam, and 2) working group with representatives from all CRPs/Centers planning to undertake activities in Vietnam for CRP2. CIAT provides overall leadership, with ICRAF as co-lead Center. In each eco-region, a lead Center and supporting CRP/s have also been identified and agreed upon.	

3.7 Staffing of Management Team and Flagship Projects

Senior Program Management Unit Staff

Name		Affiliation	Duty Station	Anticipated Role
1	Izabella KOZIELL	WLE Program Staff	Sri Lanka	Program Director
2	Emma GREATRIX	WLE Program Staff	Sri Lanka	Senior Program Manager
3	Nicoline DE HAAN	WLE Program Staff	Sri Lanka	Coordinator - Gender, Poverty and Institutions
4	David Rider SMITH	WLE Program Staff	Uganda	Manager, Monitoring, Evaluation and Learning
5	Michael VICTOR	WLE Program Staff	Laos	Knowledge Management and Engagement Coordinator

Gender and Inclusive Development (GID)

Name		Affiliation	Duty Station	Anticipated Role
1	Nicoline DE HAAN	WLE Program Staff	Colombo, Sri Lanka	Core Theme Leader, sociology, gender, institutions
2	Barbara VAN KOPPEN	IWMI	Pretoria, RSA	Gender, rural sociology, multiple use of water
3	Margreet Zwaantje ZWARTEVEEN	UNESCO-IHE	Delft, the Netherlands	Gender, water governance, water management
4	Alan NICOL	IWMI	Colombo, Sri Lanka	Political economy, governance
5	Ruth MEINZEN-DICK	IFPRI	Washington, DC, USA	Natural resource sociology
6	Katherine SNYDER	CIAT	Nairobi, Kenya	Anthropologist, participatory approaches, development
7	Marlene ELIAS	Bioversity International	Kuala Lumpur, Malaysia	Biodiversity, geographer, gender
8	Bezaiet DESSALEGN	ICARDA	Amman, Jordan	International development, gender, community development
9	Courtney PAISLEY	YPARD	Rome, Italy	Youth in agriculture, implementing support

Regenerating Degraded Landscapes (RDL)

Name		Affiliation	Duty Station	Anticipated Role
1	Deborah BOSSIO	CIAT	Nairobi, Kenya	FP Co-leader - soil science, research management
2	Keith SHEPHERD	ICRAF	Nairobi, Kenya	FP Co-leader - soil science, land health
3	Rolf SOMMER	CIAT	Nairobi, Kenya	Soil science, climate change
4	Mirjam PULLEMAN	CIAT Wageningen	Cali, Colombia	Soil ecology, land restoration
5	Tor-G VAGEN	ICRAF	Nairobi, Kenya	Soil science, landscape ecology
6	Ephraim NKOYA	IFPRI	Washington D.C. USA	Economics of natural resources
7	Louis VERCHOT	CIAT	Bogor, Indonesia	Forestry, soil science, climate change
8	Christophe BÉNÉ	CIAT	Cali, Colombia	Senior policy advisor
9	Ravic NIJBROEK	CIAT	Nairobi, Kenya	Social scientist

Land and Water Solutions for Sustainable Intensification (LWS)

Name		Affiliation	Duty Station	Anticipated Role
1	Jennie BARRON	IWMI	Colombo, Sri Lanka	FP Co-leader - Agricultural water and land management, research strategy and management
2	Anthony WHITBREAD	ICRISAT	Hyderabad, India	FP Co-leader - soil science and agronomy, managing climate risks and soil fertility
3	Tilahun AMEDE	ICRISAT	Hyderabad, India	Agronomy, watershed management
4	Ian MAKIN	IWMI	Colombo, Sri Lanka	Agriculture engineer, Irrigation operations
5	Timothy WILLIAMS	IWMI	Accra, Ghana	Agricultural economics
6	Ruth MEINZEN-DICK	IFPRI	Washington DC, USA	Social science with focus on water policy, local organizations, property rights, and poverty impacts with gender dimensions

Name		Affiliation	Duty Station	Anticipated Role
7	Alan NICOL	IWMI	Colombo, Sri Lanka	Water and land institutional settings, gender
8	Tushaar SHAH	IWMI	Anand, India	Economics –water institutions and policies
9	Biju GEORGE	ICARDA	Cairo, Egypt	Irrigation and water resource management
10	Polly ERICKSEN	ILRI	Nairobi Kenya	Livestock and natural resource management

Sustaining Rural-Urban Linkages (RUL)

Name		Affiliation	Duty Station	Anticipated Role
1	Pay DRECHSEL	IWMI	Colombo, Sri Lanka	RUL FP Leader, CoA 3.2 leader; Environmental science, (peri) urban farming, Resource Recovery & Reuse
2	Guido SANTINI	FAO	Rome, Italy	CoA 3.1 Co-leader; Water and land management; city-region food systems;
3	Mary Mrura NJENGA	ICRAF	Nairobi, Kenya	Bioenergy and RRR – Gender linkages
4	Henry NEUFELDT	ICRAF	Nairobi, Kenya	Natural resource management and climate change
5	Kalanithy (Kala) VAIRAVAMOORTHY	IWMI	Colombo, Sri Lanka	CoA 3.3 Leader; Integrated rural-urban water management;
6	Guy HENRY	CIAT	Cali, Columbia	CoA 3.1 Leader; agricultural economics
7	Marielle DUBBELING	RUAF Foundation	Leusden, the Netherlands	FP Co-leader (Uptake); Urban and peri-urban agriculture, multi-stakeholder platforms for knowledge and policy dialogue
8	Miriam OTOO	IWMI	Colombo, Sri Lanka	CoA 3.2 Co-leader business modelling and resource economics
9	Biju GEORGE	ICARDA	Cairo, Egypt	Irrigation and safe wastewater reuse
10	Josiane NIKIEMA	IWMI	Accra, Ghana	Environment and process engineering
11	Katharina FELGENHAUER	IWMI	Accra, Ghana	Social scientist for public- private partnerships

Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)

Name		Affiliation	Duty Station	Anticipated Role
1	Vladimir SMAKHTIN	IWMI	Colombo, Sri Lanka	FP Co-leader - Hydrology and water resources management
2	Claudia RINGLER	IFPRI	Washington, DC, USA	FP Co-leader - Global and regional hydro-economic analyses
3	Matthew MCCARTNEY	IWMI	Vientiane, Lao PDR	ESS, green and grey water infrastructure
4	Eric BARAN	WF	Phnom Penh, Cambodia	Fisheries and aquaculture
5	Paul PAVELIC	IWMI	Vientiane, Lao PDR	Leader - flood capture and storage; Groundwater
6	Karen VILLHOLTH	IWMI	Pretoria, RSA	Leader – groundwater initiative
7	Alam MONDAL	IFPRI	Washington, DC, USA	Energy policy, renewable energy technologies, energy economics
8	Giriraj AMARNATH	IWMI	Colombo, Sri Lanka	Disaster risk assessment and management; remote sensing
9	Mark SMITH	IUCN	Gland, Switzerland	Water security and governance, natural water infrastructure
10	Marloes MUL	IWMI	Accra, Ghana	Water storage, ESS

Enhancing Sustainability across Agricultural Systems (ESA)

Name		Affiliation	Duty Station	Anticipated Role
1	Nathanial MATTHEWS	WLE Program Staff	Colombo, Sri Lanka and London, UK	FP Co-leader - Natural resources management, political economy and ecosystems
2	Fabrice DECLERCK	Bioversity	Montpellier, France	FP Co-leader - Biodiversity and ecosystem services
3	Eike LUEDELING	ICRAF	Bonn, Germany	Leader – Decision analysis, decision modeling under risks and uncertainty, participatory model building, climate change analysis
4	Lisa-Marie REBELO	IWMI	Vientiane, Lao PDR	Leader - Information systems, remote sensing and GIS
5	Fred KIZITO	CIAT	Nairobi, Kenya	Land degradation, soil fertility decline, water scarcity and loss of biodiversity
6	Wei ZHANG	IFPRI	Washington DC, USA	Environmental economics and ecosystem services
7	Becky Chaplin KRAMER	Stanford University	Stanford, California	Mechanics and modeling of ecosystem services

Name		Affiliation	Duty Station	Anticipated Role
8	Alexander MUELLER	UNEP TEEBAgFood	Potsdam, Germany	Societal and political dimensions of sustainability, large scale
9	Wim BASTIAANSSEN	UNESCO-IHE	Delft, Netherlands	Soil-water-atmosphere systems with specialization in soil physics
10	Kim GEHEB	WLE Program Staff	Vientiane, Laos	WLE Mekong Regional Coordinator

3.8 Open Access (OA) and Open Data (OD) Management

3.8.1 Introduction

The WLE Open Access and Data Management Plan outlined below has been developed as part of the IWMI and WLE Open Access/Open Data Implementation Plan submitted to the Consortium Office in June 2015. This OA/OD Implementation Plan is based on the CGIAR Open Access and Data Management Policy (adopted in 2013), and the CGIAR Open Access and Data Management Implementation Guidelines (adopted in 2014).

Open Access and Data Management are critical components to all stages of WLE's impact pathway. At the discovery level, WLE aims to collect, generate and share data efficiently amongst core research partners. At the outcome level, WLE intends to use models and decision analyses to inform decisions on land, water and ecosystem management. At the wider impact level, WLE intends to ensure that its data, models and tools are accessible and can be widely used through Linked Open Data and other mechanisms to better expose our data.

The objectives of the Open Access and Data Management Plan are to:

- Summarize the information products that fall under the OA/OD plan
- Lay out key infrastructure that will be used and how it will be managed
- Provide an overview of the protocols for collecting and managing information
- Outline resources (human and financial) that will be committed to the OA/OD

3.8.2 Open access and data management plans

Information products that we will collect/manage: Overall, WLE's OA/OD strategy is guided by two over-arching principles. The first is to avoid duplicating efforts with center data management strategies and plans. This means that WLE will focus on aggregation and harvesting. WLE will collect data from non-CGIAR partners (i.e. NARS or regional organizations) where data and information commissioned by WLE might be lost. Second, WLE will ensure that data management is an integral part of its knowledge integration and synthesis efforts to ensure that data collected can be used by researchers and others.

WLE prioritizes the following information products:

- Knowledge products: Peer-reviewed versions of journal articles; self-published journals, books, reports, and other papers; externally or commercially published books and book chapters; management and governance reports
- Videos and images: Video, audio, scientific images and photographs
- Databases and models: Biophysical, social and combined models
- Prioritized data and data sets: data and data sets that are produced by projects or could be of strategic value)
- Tools: WLE will collect tools that are in the public domain and can be widely shared across the program and with others.

Storage and preservation of information products: WLE has the following storage points:

- Publications: WLE uses CGSpace and has an open access policy in place.
- Data: all databases and models are stored in partners' own institutional databases, WLE will use Dataverse to collect meta-data on data sets, models and databases, it will also house data from non-CGIAR partners so that this data is appropriately stored.

- For internal documents, contracts and non-public information, WLE uses sharepoint.
- WLE is developing a solutions and tools platform to act as a gateway to highlight key data, models, databases and tools produced by WLE partners.

Intellectual assets: All contracts established with CGIAR centers and other partners stipulate that data is to be made openly available. WLE Partner Agreements contain clauses on Intellectual Assets (IAs) and Intellectual Property (IPs) that are in compliance with the CGIAR Principles on the Management of IA. Partners are informed in advance and during the negotiation of contracts, agreements and MoUs of the requirements to have provisions with regard to the sharing of IP rights and related Open Access provisions.

Formats for sharing: For data management, IWMI and WLE use the ISO 19115 minimum standard and it will be mapped to 'CG Core' (draft metadata elements). Some of the key formats to be used include: pdf (for all publications); CSV, Plain Text, XML (for data sets), satellite images and vector data sets (.tif/.img and .shp). WLE publications and materials will be put into its collections on CGSpace. CGSpace meta-data is compliant with CGIAR Core.

Quality assurance: Quality assurance, data management and storage are the responsibility of the researchers and science managers at the main centers. For non-CGIAR partners, the IWMI GIS, RS and Data Management (GRandD) Unit will provide overall back up and support. For management of WLE's Open Access Repository for publications, the IWMI Information and Knowledge Group will play a coordinating role.

Types of licenses and translations: Currently, IWMI and WLE are using Creative Commons license (BY-NC 3.0 and BY-4.0) for publication and materials. WLE expects projects to budget for translation of materials into appropriate languages, particularly for uptake purposes.

Promotion and capacity strengthening: WLE will implement a number of strategies to promote and institutionalize the OA/OD policies:

- Each center/project will have an OA/OD champion who will ensure implementation
- Improvement of simple toolkits and guidelines that have been developed (see: https://wle.cgiar.org/sites/default/files/documents/WLE-Publications-Policy-2015_0.pdf)
- Promotion of Open Access on the WLE Blog
- Improved access to WLE partner databases through the WLE website and solutions portals
- Participation and engagement with the CGIAR wide community of practices on OA/OD
- Annual review and monitoring of progress.

Challenges and Solutions:

Challenges and needs	Solutions
Given the budget constraints it will be difficult to establish and manage a full service data management plan for WLE	• WLE will work through its partners and aggregate and harvest information and data • WLE will require projects to have their own data management plans in-line with center OA/OD plans.
Difficult for non-CGIAR partners such as NARS to manage their own data	• WLE will provide spaces to manage data

Challenges and needs	Solutions
Attaining full open access by 2018 will be difficult given budgets and understanding of researchers	• WLE will take reasonable steps to make sure publications and journal articles are open access • Ensure that OA/OD is part of incentive system (IOPs) • Internal awareness raising to inform research and promote OA/OD
Sharing original source data is difficult due to proprietary rules	• WLE tends not to share original data, but products that are derived from it are open

3.8.3 Technical considerations and operations

Interoperability: The mechanisms in place to enable the cross-system transfer of content or metadata include:

- Publications: Open access based uniform resource locator (URL) and manually processed. (Research Document Information Format (RDF) feed + comma-separated values (CSV)
- Data: OAI-PMH protocols in place.

Metadata is transferred between systems (internally or externally) via:

- IWMI publications: via CSV and OAI-PMH EXtensible Markup Language (XML) (CGSpace currently does not check for duplicates).
- Data: metadata is transferred internally, OAI-PMH compliant.
- Each repository is OAI-PMH compliant. For CGSpace, these interoperability protocols will be more efficient with the platform upgrade to DSpace version 5.
- New and emerging frameworks under consideration for adoption in the next 1-2 years include Dataverse (for WLE's data), OAI-PMH and RDF.

The goal is to have linked open data and OAI-PMH protocols for both publications and data. Publications already have OAI-PMH, but use the local database. Therefore, the goal here is to make it OAI-PMH output by type (the same database could be used with coding, funding, personnel or the CGSpace protocol could be used). With reference to linked open data, the next version of CGSpace is expected to have such protocols (to be determined: 2016).

Metadata: For data management, IWMI uses the ISO 19115 minimum standard and it will be mapped to 'CGIAR Core' (draft metadata elements). The same also applies to WLE. ISO 19115 defines the schema required for describing geographic information and services by means of metadata. It provides information about the identification, extent, quality, spatial and temporal aspects, content, spatial reference, portrayal, distribution, and other properties of digital geographic data and services. Although ISO 19115 is applicable to digital data and services, its principles can be extended to many other types of resources such as maps, charts and textual documents as well as non-geographic data.

With reference to publications: WLE already uses Dublin Core metadata elements; there are only a few elements missing from CGIAR Core. The aim is to populate approximately 200-500 records from 2014 onwards with metadata records that weren't being used before. AGROVOC terms are currently used. WLE uses both AGROVOC and a standardized keyword list.

Backup: There is a backup plan in place for IWMI's Water Data Portal, which includes both on-site and off-site backups. A backup plan also exists for publications, which includes both on-site and off-site backups on a daily, weekly and monthly basis.

3.8.4 Coordination and decision making

Overall governance and reporting structure: The WLE OA/OD plan is overseen by IWMI staff responsible for OA/OD along with the WLE KMC coordinator. The ESA flagship will play a key role in supporting data sharing across the program and with other CRPs. A working group will be established with key data managers at each of the partner centers to help oversee the implementation of the plan. They will meet regularly to review the implementation and assess ways to improve systems and procedures. Data management flows will be established and followed (as shown in *Figure 3.8.1*). The roles and responsibilities are summarized in *Table 3.8.1*.

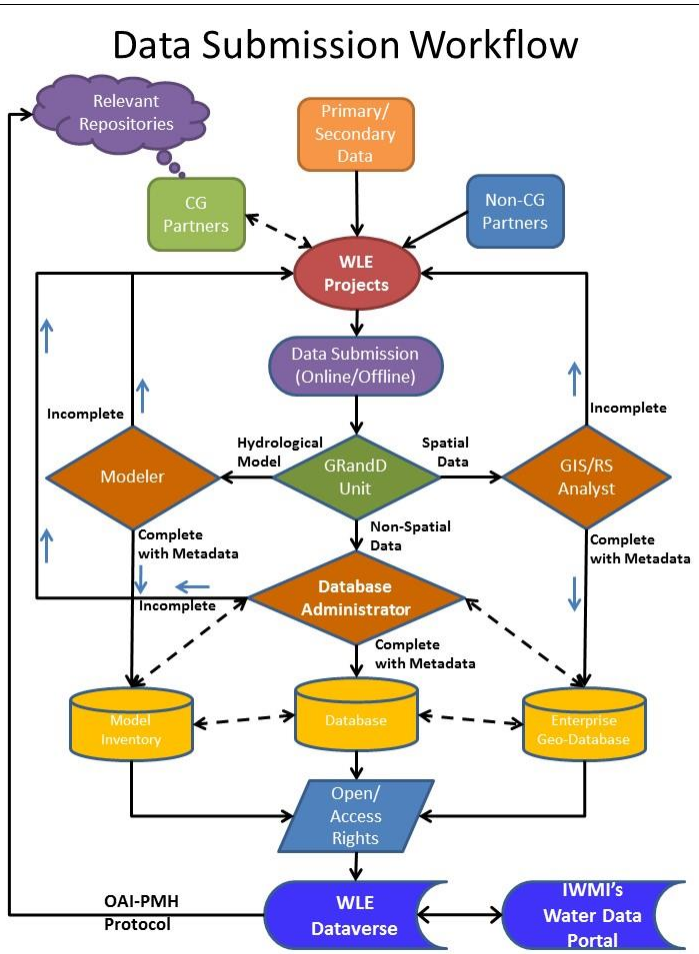
Table 3.8.1 Core Roles, Staff and Responsibilities

Role	Responsibility	Who
WLE/IWMI Core Team	• Develop plans for knowledge sharing and integration across WLE • Oversee implementation of plan, budgeting and resources	WLE KMC, ESA, IWMI IKG, IWMI GranD unit
Open Access implementation	• Oversee OA strategy and collection of publications and materials from partner canters	IWMI IKG and Flagship Leaders
Open Data implementation	• Oversee OD strategy and updating of plan • Collection of open data including meta data standards, interoperability, development of procedures and protocols • Establishment and maintenance of a data verse	GRandD Unit
Platform develop and cross integration	• Link to and develop knowledge platform for WLE solutions and data	ESA Flagship and WLE KMC
Working Group OA/AD	• Support implementation at partner centers and project teams to develop OA/OD plans • Support inter-operability efforts • Provide feedback and inputs into WLE OA/OD plans and procedures	Data managers from each center Librarians/OA support from each center

3.8.5 Data management workflow

As shown in the data submission workflow (*Figure 3.8.1*), each project is responsible for its own data which will be collected in various ways. For IWMI projects, the data workflow will follow standard processes and protocols of the GRandD unit. For CGIAR partners, data would be deposited and managed in their own databases and then harvested using OAI-PMH protocols into Dataverse. For non-CGIAR partners, data will be submitted to Dataverse and managed through the GRandD unit.

Figure 3.8.1: Data Submission Workflow



3.8.6 Draft budget

A full budget has been prepared as part of the IWMI and WLE Open Access/Open Data Implementation Plan

This will fund: open repositories (CGSpace, Dataverse), the WLE website to promote and link other databases and models, staff (one full KMC staff and one half-time support to the IWMI library) and promotion and training in open access and open data. IWMI IKG and GRandD will provide support services through Research Coordination and Quality Control (RCQC) costs. Paying for open access journals is the responsibility of the flagships and projects. Some of the open access databases and data management across the program will be supported from the ESA budget as they have responsibility for ensuring data integration across the program. Membership fees for certain journals, Altametrics and development of ORCID will be provided through the lead center. Finally, all promotional and capacity development activities will be paid out of the KMC Unit.

Appendix to Annex 3.8. Identification of Repository or Platform Housing Information Products from CRP Projects and/ or CoAs and/ or Flagship Programs for Indicative Datatypes

	Repository or Platform			
Indicative Datatype	**Name**	**URL/s**	**Flagship**	**Access type (Open/closed)**
Documents	WLE CGSpace	https://cgspace.cgiar.org/handle/10568/34494	Program level	Open
Meteorological, hydrological, socio-economic, spatial data layer, satellite images, hydrological model setups	IWMI Water Data Portal	http://waterdata.iwmi.org/	VCR	Open
Waste Water Irrigation	Municipal Wastewater Database (on AQUASTAT)	http://www.fao.org/nr/water/aquastat/wastewater/index.stm	RUL	Open
Water scarcity indicators	IFPRI Food Policy e-Atlas: Water Indicators	http://tellmaps.com/ifpri/#!/tellmap/880388529	VCR	Open
Land, soils, agroforestry	WLE ICRAF Datasets	https://dataverse.harvard.edu/dataverse/WLE-ICRAF	ESA RDL	Open
Land, soils, agroforestry	ICRAF Spatial Data	http://landscapeportal.org/	ESA RDL	Open

3.9 Intellectual Asset Management (IA Management)

WLE focuses on the sustainable management of water and land resources as a way to establish better functioning ecosystem services while meeting food demands and achieving economic growth. Its research complements research on specific commodities and value chains by developing, testing and scaling out best practices, business models, innovative tools and incentive mechanisms which promote sustainable agricultural production.

All data, information and knowledge generated through the development of these practices, tools, business models and incentive mechanisms are made publicly available with a view to ensuring maximum access and use, notably by:

- Making relevant databases and knowledge platforms available online;
- Promoting the use of social online tools such as WLE blogs for wide information sharing;
- Working in partnership with local and national organizations and stakeholders in all key geographical locations of WLE and at all stages of the research and project design, implementation and scaling up;
- Ensuring the sound management of Intellectual Assets (IAs) through adequate project monitoring and reporting across the WLE CRP; and
- Earmarking resources at flagship and CRP levels for capacity development on IA issues and open access dissemination. Dissemination of IPGs is outlined in the impact pathways and the Knowledge Management and Communication Strategy.

3.9.1 Planning and tracking of IAs

WLE will follow and implement the policies and procedures of the lead center (IWMI) on the sound management of IAs for all its project activities across the flagship portfolio:

- IWMI Legal and Contracts Officer reviews all WLE-related agreements to ensure full compliance with CGIAR IA principles.
- Partners are informed in advance and during the negotiation of contracts, agreements and MOUs of the requirements to have provisions with regard to the sharing of Intellectual Property (IP) rights and related Open Access provisions.
- WLE Partner Agreements contain clauses on IAs and IPs that are in compliance with the CGIAR Principles on the Management of IA.
- All other partner agreements also include required provisions to ensure the sound management of IAs and IPs in accordance with relevant applicable laws and best practices.
- A record is kept of Limited Exclusivity Agreements or Restricted Use Agreements in order to provide full justification to the CGIAR that such agreements are contributing to the furtherance of the CGIAR vision. The same is done for Trade Marks reporting.
- All WLE projects use IWMI project reporting template which includes a separate section on IA issues highlighting important IAs that have been used for, and generated by, the project

3.9.2 Capacity and decision-making related to intellectual assets management

The WLE team will work in close collaboration with IWMI's Legal and Contracts Officer who has overall responsibility for reviewing all WLE partner agreements and ensuring full compliance with CGIAR IA principles. IWMI Legal and Contracts Officer will also work closely with counterparts of WLE partners. The IWMI Legal and Contracts Officer is a member of ClipNet, the CGIAR community of

practice of all center-based IP focal points. The WLE Management Committee will be informed of all major IA and IP related issues and will have decision-making authority over the restricted use of IP where relevant.

3.11 Knowledge Management, Engagement and Communications

3.10.1. Introduction and lessons from Phase 1

In this strategy, communication, information management, knowledge management and uptake are treated as a family of interlinked disciplines and activities that are essential to help research move from outputs (journal articles and international public goods) to outcomes (changes in knowledge, attitudes and how decisions are made). Impact happens through people, not simply by delivering information products or messages.

In Phase 1, WLE's knowledge management and communication (KMC) functions were successful in moving forward its agenda and research (see this presentation and infographic on the WLE Thrive Blog). Some reflections and lessons learned from Phase 1 include the following:

- **It is essential to build partnerships and a coalition of the willing**: WLE KMC has been successful in building a core group of KMC staff from partner organizations and focal regions. Leveraging partners' knowledge, skills and outreach efforts strengthens WLE and increases potential for uptake of research-based development options.
- **Articulating and continually refining WLE's message is essential for marketing and branding efforts**: KMC has been successful in helping to articulate the program's core messages and value proposition. The Thrive Blog, in particular, has fulfilled a niche for critical discussion on sustainable intensification of agriculture and ecosystem services (see big questions).
- **More emphasis should be placed on producing knowledge and synthetic products**: WLE has produced a number of promotional materials, but fewer knowledge and synthetic products. Better synergies to repackage and produce synthetic materials are needed in Phase 2.
- **To change practices and policies, there is a need to develop relationships (trust) and engage with stakeholders** (such as policymakers, international financial institutions, donors and development partners). This requires the strategic use of a wide variety of channels, including events; relationship and trust building approaches; face-to-face discussions and interactions as well as producing materials to engage them, such as briefs; and media engagements. This could be on developing policy platforms and fora to engage policymakers, such as the IWMI-Tata policy partnership and the Mekong Regional Forum.
- **Capacity development is an important aspect of KMC**: WLE continues to strengthen researchers' ability to communicate effectively to research users through more appropriate products, face-to-face interactions or use of new media (social media and blogs). One example is the tools for uptake processes and improving engagement with project cycles that were developed as part of the focal region process.
- **Internal knowledge sharing and social learning** has high value, but has been practiced with varying degrees of success during Phase 1 of WLE. Dedicating more resources to maintaining internal sharing networks (wikis, etc.) and including more internal learning reflections, and other means, will be used to strengthen these efforts during Phase 2.

3.10.2. WLE KMC Phase 2

The overall approach: *Figure 3.10.1* highlights how KMC supports the WLE Theory of Change. The overarching approach is to work with targeted public policymakers (government policymakers, investors, international financial institutions, donors, and partners) to bring about widespread change in behavior by changing the incentive frameworks.

WLE KMC advocates using a range of channels and media to engage and reach targets. Given that WLE is focused on changing attitudes and practices, it will use two important concepts: '*priming*' and '*framing*'. 'Priming' is used to stimulate interest of potential partners in collaborating. This can be through engaging on a regular basis so they are aware of ongoing activities, see benefits in emerging research results, and are 'primed' to collaborate when the right time presents itself. Also, by providing similar messages in different forms or through communication channels, so that target audiences are seeing messages that are reinforced through multiple spaces. 'Framing' is used to manage/facilitate dialogues so that messages and evidence are put into the proper narrative.

Figure 3.10.1 highlights the range of approaches and tools that will be used to engage with these different stakeholders at different levels.

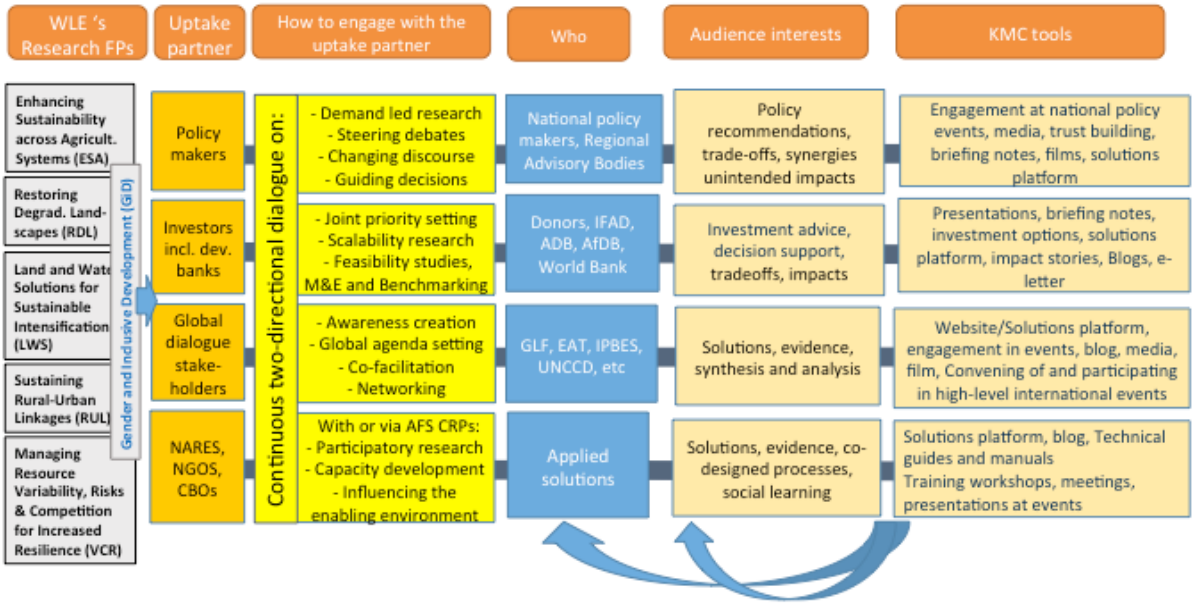


Figure 3.10.1. Range of Approaches and Tools Used to Engage with Different Stakeholders at Different Levels.

WLE KMC will support the overall WLE KMC through the following pathways:

- **Developing the evidence base**: To strengthen the articulation and promotion of, and dialogue on, WLE research products and solutions, especially in relation to the costs, benefits and trade-offs of sustainable intensification of agriculture, such as through a web-based solutions platform and messaging.

- **Strategic communication**: To present the results, achievements and progress of WLE within CGIAR and to core stakeholders to ensure that WLE is positioned as a leading program on issues related to sustainability at scale, such as by continuing to evolve WLE messaging, engaging presentations, the website, annual reports, and change stories series.

- **Building relationships and reaching out**: To support flagships, site integration and projects to engage with and improve relations with key targets at national, regional and global levels. This will be done by strengthening the use of engagement strategies and tools for building relationships with key decision makers and organizational bodies, supporting roundtables and fora, and developing linkages to media and journalists (regular op-eds, releases for papers).

- **Knowledge management**: To strengthen synthesis and learning across WLE. This also includes efforts to ensure that WLE open access and data management policies are complied with and promoted.

Program- and flagship-level KMC: At the **program level**, the main activities in WLE Phase 2 focus on the following:

1. **Coordinating engagement and outreach efforts:** KMC will support outreach and engagement efforts in key dialogues at the global level, such as the Global Landscapes Forum (GLF), the Sustainability Summit of *The Economist*, etc. This will also include reaching out to the media, and ensuring that WLE messages and science are regularly seen in op-eds, news stories and profiles in international and regional outlets.

2. **Showcasing and presenting WLE evidence through the solutions portal**: This is a space to showcase and discuss emerging WLE results and evidence on how to reduce ecosystem degradation from agriculture while maintaining and even improving agricultural productivity. The portal will focus on a synthesis of WLE results and on demonstrating the efficacy of an ecosystem service-based approach. It will include data visualizations, models, publications, interactive media, etc. The Thrive Blog will also provide a space for critical discussion on potential pathways for sustainable agricultural intensification. The blog will also engage with the media and other outlets to ensure stories are disseminated more widely.

3. **Marketing efforts:** KMC will support marketing efforts in reaching out to potential donors as well as to potential investors for scaling-up WLE solutions. This will include working with researchers to develop strategic messaging and selling points of different solutions based on context and outreach, including producing an annual report, outcome stories, visually stimulating presentations, a minimum set of promotional materials, and a communication resource kit, to provide partners with easily accessible templates and guidelines to apply to their work.

4. **Social learning and knowledge-sharing platforms:** KMC will support efforts to improve sharing and learning between and amongst flagships and scales. This will include facilitating learning through workshops, science meetings and online platforms, such as discussion groups, webinars and support to communities of practice. KMC will also maintain platforms, such as SlideShare, YouTube, CGSpace, Office 365, etc., to ensure that WLE research is better captured.

At the **flagship level,** the focus will be on integrating and demonstrating the impacts and results of the research. We will also support improving uptake and communication of results to specific research users. Much of this work will be done with uptake/communication staff based at the lead flagship centers. Flagship-level KMC efforts will include the following:

1. Strengthening research users' ability to reach out and engage with decision makers, in order to create widespread change through policy and incentive frameworks. This will be done through trust building, improved engagement and development of specific materials.

2. Supporting the development of knowledge products – manuals, business models, interactive tools for different users, etc.

3. Development of briefing notes with clear recommendations targeted to different users.

4. Supporting the facilitation of dialogue and multi-stakeholder processes to ensure research solutions are appropriate and understandable to different users.

5. Production of materials for use in development processes (participatory video, working with press, radio, TV).

6. Supporting target country site integration through the integrative flagship, ESA.

Crosscutting issues:

Messaging: WLE will focus its messaging on how its research adds new knowledge to ways in which agriculture can positively contribute to improved sustainability at scale (landscape, watershed, river basin, etc.). KMC plays a central role in defining and articulating these messages. KMC will continue to guide WLE's messaging and overall brand identity in collaboration with WLE scientists. An important consideration will be to ensure that WLE is seen as a thought leader and provider of critical inputs to debates around the issues of ecosystem-based approaches and sustainable intensification.

Open access and shared services: KMC will also lead efforts to promote and ensure compliance with WLE's Open Access and Open Data Strategy and plans. KMC has developed a publications policy. As mentioned in the Independent Evaluation Arrangement (IEA) review in 2016, this publication policy needs to be better complied with by researchers and centers. One way this will be done is to promote open access through the Thrive Blog. In the past, the blog has been able to get journal articles open for a limited period of time through a blog post.

WLE places a high priority on collaborating with other CRPs. This will be particularly important in Phase 2, where resources are scarce. WLE is one of the founders of the KM4CRPs events that brought CRPs together to share experiences in implementing KMC. WLE has also bought into shared services such as CGSpace and Office 365.

Monitoring and evaluation: WLE KMC regularly monitors and tracks how its products and services are performing. It has developed systematic analytics on its different products. In addition, it carries out regular user surveys to understand how its services are being used and how it can improve. In Phase 2, WLE KMC will explore how knowledge products and materials are contributing to achieving WLE impacts and outcomes by developing more analytical evaluation systems of the materials produced.

3.10.3. Operationalization

Given budgetary constraints, WLE KMC will maximize and leverage staffing and resources from the International Water Management Institute (IWMI) and other partners. Some of the ways this will be done include the following:

- Annual work plan: WLE will identify annual communication goals based on priority activities to be outlined in the annual Program of Work and Budget (POWB).

- Joint identification of priorities: Discussions will take place with flagship leaders and KMC staff at partner centers to identify 'low-hanging' fruit and areas where KMC can be leveraged to further the delivery of outcomes. This will ensure that activities are complementary to priorities of partners and can build upon existing resources.

- Allocation of funding at flagship and project levels for KMC: Funds for specific project-level communications with research users will be allocated at the flagship and project levels. Partner KMC staff or program-level staff can be used to support these activities.

Roles and responsibilities: Experience from Phase 1 shows that when KMC staff are embedded or working closely with flagships, focal regions or projects, outreach and uptake efforts are more successful. Based on this, WLE will continue to promote a decentralized approach to how KMC is carried out. The following roles and responsibilities are envisioned amongst KMC staff.

WLE Knowledge Management and Communications (KMC): Responsible for overall messaging and marketing for the program; coordination of the partnership strategy/engagement; management of the website, Thrive Blog and knowledge management platforms across the program; facilitating meetings; and developing guidelines to be used by flagships and projects to improve uptake and delivery of results. It is expected there will be one program-level staff member responsible for KMC. He/she will be part of the WLE Operations Team and will also work closely with IWMI's Communication and Marketing Division. This person will most likely work 70% for the program and will outsource their remaining time to projects.

Flagship-level KMC: Flagships will have some support from KMC staff in the strategic partner centers. Their main roles will be to: 1) develop and implement communication and engagement plans for the flagship; 2) support projects with communication; and 3) develop knowledge products, stories and communication materials specific for the flagship.

A list of potential support staff for different flagships is given in *Table 3.10.1.*

Table 3.10.1. Potential Support Staff for Different Flagships

Flagship	Lead centers	Communication/uptake staff
FP1: RDL	International Center for Tropical Agriculture (CIAT), World Agroforestry Centre (ICRAF), Bioversity International,	CIAT, ICRAF and Bioversity International all provide thematic KMC support to RDL
FP2: LWS	IWMI, ICRISAT, International Center for Agricultural Research in the Dry Areas (ICARDA)	IWMI's IKG would take lead with support from partners
FP3: RUL	IWMI	IWMI's IKG and a product development specialist working on RUL
FP4: VCR	International Food Policy Research Institute (IFPRI), IWMI	IWMI and IFPRI to provide support
FP5: ESA	IWMI, ICRAF, Bioversity International	WLE KMC and regional offices, and ICRAF on clusters of activities (CoA) - CoA 2

Regional level: National- and regional-level communications are essential for uptake and to reach specific audiences, such as governments, nongovernmental organizations (NGOs) and civil society. WLE has established a strong network of communicators in the different countries and regions where it will continue to strengthen and work through in its main geographic regions including the following:

- Ganges (India, Bangladesh, Nepal): IWMI offices in India and Nepal, WorldFish office in Bangladesh.

- Mekong (Lao PDR, Vietnam, Myanmar, Cambodia and China): WLE Greater Mekong and IWMI Southeast Asia Office KMC teams.
- East Africa (Ethiopia, Uganda, Tanzania, Kenya): IWMI East Africa and Nile Basin Office.
- West Africa (Nigeria, Ghana, Burkina Faso): IWMI West Africa Office.

3.10.4. Budget

Given the current budget scenario, it is expected that a modest budget will be allocated from the Operations Team Budget to cover the salary of a KMC staff member and core activities that contribute to marketing and engagement at the program level. This will be supplemented by additional funding for large regional and international events or investments in communication products from donors and investors. Flagship and project leaders will designate staff who are responsible for communications, and earmark funds for communication products and initiatives as part of their overall budgeting. Project funds may be allocated to a CGIAR center's central communications team, or a scientist working on the project can act as a designated focal point for communications and work in close collaboration with a communications specialist.

3.12 Issues Raised on the Pre-proposal by the ISPC and Responses in the Full Proposal

In the case of WLE, the feedback from the ISPC occurred in two discrete steps, one following the submission of the original WLE pre-proposal on August 17th 2015, and the second following the re-submission of the pre-proposal on January 15th 2016. In the following table we include the points raised by the ISPC on the original submission, our response at that time and how these issues were addressed in the re-submission, the feedback from the ISPC following the re-submission and subsequent points highlighted, and finally the specifics of what is now reflected in the full proposal. Other significant changes are also summarized at the end of the table.

ISPC Feedback & recommendations (Sept 29th, 2015)	**Response in pre-proposal re-submission (January 15th, 2016)**	**ISPC feedback on re-submitted pre-proposal (February 5th, 2016)**	**Response in full proposal (March 31st 2016)**
The ISPC reflected positively on the need for the program as part of the overall CRP portfolio in addressing the natural resources goals of the SRF, which is consistent with the recently approved SDGs. The ISPC recognized the relevance and strength of much of the research for development proposed in the program as a whole and the flagship projects (four of which scored satisfactory 'B' rating). However, there was a need to describe a clarity of focus, Theory of Change, outcome orientation	By sharpening the focus of the proposed program, and reducing the breadth in several areas, we believe that we can demonstrate how the issues of coherence and (over) ambition raised in the commentary will be addressed.	"*The resubmission suggests a much more coherent and well-structured approach than the pre-proposal documentation. The Theory of Change and relationship among the flagships is much clearer, and the reader can start to envisage synergies at the portfolio level. The re-write shows evidence of the proponents having taken on board lessons from both ISPC feedback and the IEA evaluation of WLE. The impression is that the CRP is much more realistic and practical about what can feasibly be achieved by CGIAR research and development activities, but there remains a*	In the process of developing the full proposal we have focused on clarifying WLE's role as an integrating CRP, strengthening the overall coherence, enhancing the theory of change, simplifying the structure, and clarifying how the elements address sustainability and NRM challenges within the program and the portfolio as a whole. We have also aimed to maintain a realistic level of ambition while accommodating the feedback and recognizing the realities of reduced scale of budgets for the portfolio as a whole and WLE in particular. Particular attention has been paid

ISPC Feedback & recommendations (Sept 29th, 2015)	Response in pre-proposal re-submission (January 15th, 2016)	ISPC feedback on re-submitted pre-proposal (February 5th, 2016)	Response in full proposal (March 31st 2016)
and integration potential of the Program as a whole.		*need to strengthen the evidence base on the comparative advantage of WLE with respect to some of the landscape approaches proposed.*"	to strengthening the evidence base and WLE's comparative advantage within each of the flagships, and the program as a whole.
Recommendation 1: "*Phase 2 of WLE should be more closely integrated in sites where the agri-food CRPs are working"*.	**Response 1:** In developing the pre-proposal re-submission, discussions were held with AFS-CRPs in relation to collaboration.	*"The proponents have provided a robust and comprehensive response to this critique of the original pre-proposal. The resubmission demonstrates serious intent towards better integration with the agri-food CRPs. This is particularly evident with the recasting of the Flagship Project on Integrating Ecosystems Solutions as a flagship on Enhancing Sustainability across Agricultural Systems (ESA). This change should make WLE more oriented towards the demands of the agri-food CRPs, and the specific areas of focus outlined in table 1 for collaboration with DCLAS, Rice, Livestock and FTA are appropriate and demonstrate that the agri-food CRPs see a value in*	With the goal of developing and operationalizing the collaboration with the AFS CRPs, throughout the full proposal development process, WLE has engaged further with the AFS CRPs on specific areas of cooperation. Through the ESA flagship, a particular emphasis has been placed on working with DCL, FTA, Livestock, and RICE to co-develop a framework for benchmarking sustainability. Details on this collaboration and the other key areas are presented in the full proposal and relevant annexes.

ISPC Feedback & recommendations (Sept 29th, 2015)	Response in pre-proposal re-submission (January 15th, 2016)	ISPC feedback on re-submitted pre-proposal (February 5th, 2016)	Response in full proposal (March 31st 2016)
		working with WLE. The ISPC commends the proponents for their diligence in engaging with the AFS CRPs."	
Recommendation 2: "*Greater clarity is required with respect to the key leverage points for research to make a contribution in the impact pathways – both in aggregate and at flagship level. Clearer, simpler and more logical Theories of Change are required at both aggregate and flagship level in order for the CRP to effectively convey how its activities will bring about impact, and what the major assumptions are that underlie these theories*".	**Response 2:** We agree that further elaboration of the overall theory of change and impact pathways can be provided and is being addressed. We will provide clearer assumptions and streamlined impact pathways, focusing in particular on the relevance of the research to achieving specific SRF SLO targets, and on how the Program as a whole will deliver this as a cross-portfolio integrating CRP. The major assumptions theories will be elaborated. It is encouraging though to see the ISPC comment that the theories of change and impact pathways within each Flagship Project are generally plausible. These are being further strengthened and clarified at the overall program level.	*"The section on Theory of Change in the resubmission is a significant improvement over the original, with a much clearer aggregate view of the program provided in figure 1.3. There is considerable evidence in the paragraphs preceding figure 1.3 of the proponents taking Theories of Change seriously as a tool for managing and adapting the program over time. Given this much stronger foundation, the full proposal will need to get more specific but the clarity with which the assumptions underlying the Theory of Change have been laid out is welcomed by the ISPC.* *In the section on partnerships, however, the strategy would be more convincing if definitions of 'discovery' and 'implementation and boundary' partners for example had been given. A*	Clearer, simpler and more logical **Theories of Change**, research questions, impact pathways, and assumptions have been developed and incorporated into the full proposal. Building on the evidence from phase 1 of WLE and other sources, the overall theory of change and impact pathways have been elaborated. Greater emphasis has been placed on the relevance of the research to achieving specific SRF SLO targets, and on how the program as a whole will deliver this as a cross-portfolio integrating CRP. The theory of change and impact pathways in the main narrative, as well as those for each of the flagships, are further refined in the full proposal with clear emphasis on learning loops.

ISPC Feedback & recommendations (Sept 29th, 2015)	Response in pre-proposal re-submission (January 15th, 2016)	ISPC feedback on re-submitted pre-proposal (February 5th, 2016)	Response in full proposal (March 31st 2016)
		rigorous typology, including how each type of partner contributes to delivery of impact would give further confidence that impact will be delivered. *The resubmission is right to highlight the myriad challenges facing progress towards sustainable intensification, and the proponents should bear in mind the fact that evidence of impacts from the kinds of landscape approaches that WLE see as their comparative advantage is seriously lacking. In the full proposal, the proponents will be expected to present specifics of what is necessary and sufficient to bring about positive change in the landscapes in which they work."*	The typology of partners and their roles as to how they support delivering on impact are presented in the partner section in the main narrative and the annex on partner strategy. Specific details as provided in each of the flagships. We acknowledge the paucity of robust evidence of impacts from the approaches necessary for research in natural resources management. Therefore, in addition to the details on the process outlined in the theory of change, we have also identified the additional impact assessments that we will undertake within each flagship of the program. These are also summarized within the results based management (RBM) annex of the proposal.
Recommendation 3: "*The Core Theme on Gender and Inclusive*	**Response 3:** We do appreciate the need to better reflect the momentum of the gender research	*"The proponents have revised the Core Theme – now called Gender and Inclusive Development (GID) –*	With an emphasis on a realistic approach, the Gender and Inclusive Development core

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Growth should be seriously reconsidered"	component throughout the program, and specifically in its role in influencing the research agenda in each of the Flagships. We propose to strengthen the analysis and approach while better focusing the overall ambition by taking a more functional approach around key research questions both for WLE Flagships and in support of NRM aspects as they appear in other parts of the portfolio.	*with a much more realistic approach to gender. There is a GID coordinator supporting work in all five flagship projects, and the budget for GID (as for Monitoring, Evaluation and Learning) is embedded within the flagships. The three questions on page 17 give the reader a flavor of the kind of insights we might gain through GID, but the section could be strengthened by including some discussion on methods and research design."*	theme coordinates the gender research embedded within all five of WLE's flagships. The relevant details on research methods and design are presented in subsection 6 (cluster of activities) and sub-section 9 (gender) of each of the flagships.
Recommendation 4: "*The Flagship 5 on Sustainability, Ecosystems and Resilience has a particularly unconvincing Theory of Change, though there are some strong features that could be incorporated elsewhere in the CRP".*	**Response 4:** The Sustainability, Ecosystems and Resilience flagship was discontinued. The high priority elements of research on biodiversity were consolidated into a revised RDL flagship, and a reduced component on the application of the Sustainability Framework has been incorporated into the ESA flagship.	This recommendation has been acted on.	No further action required.
Recommendation 5: "*Flagship project 6 on Integrated Solutions*	**Response 5:** This flagship will be consolidated and significantly	This recommendation has been acted on.	In response to the ISPC recommendation, IEA comments,

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into Policy and Practice should be re-conceptualized and activities redefined".	restructured in response to ISPC and IEA comments, including co-development on sustainable intensification. A new flagship (ESA) was developed for the re-submit.	**Comments on new Flagship Project 5 – Enhancing Sustainability across Agricultural Systems (ESA)** *The new ESA flagship project describes a coherent set of two clusters of activities focusing on: 1) measurement of sustainability in focal landscapes of CGIAR collaborating countries in Asia and Sub-Saharan Africa, and 2) cross-disciplinary decision-support. Activity cluster 1 builds on the investment made in Phase 1 of WLE on building an Ecosystem Service and Resilience Framework, but proposes to link more closely to the needs of agri-food systems CRPs. As noted already, this addresses recommendation 1 from the ISPC commentary on the original pre-proposal, and the proposed starting point of collaboration with four agri-food CRPs is sensible and feasible.*	and subsequent reduction of the portfolio budget, the Enhancing Sustainability across Agricultural Systems (ESA) Flagship, which builds on the research and partnership networks developed to date, focuses on considering sustainability at scale in the target countries and regions, in particular through its emphasis on natural resources management across targeted AFS-CRPs, and development of a portfolio-wide indicator framework for sustainable agriculture intensification. This is designed to support country efforts to implement the related SDGs. This Flagship has coordinated the dialogue with the AFS CRPs to prioritize and co-develop research on sustainable intensification within the site integration programs of the CGIAR. Details are provided in the main narrative, ESA flagship, and the

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		Activity Cluster 2 builds on an area of strength within ICRAF. The interaction of these two clusters of activity offers the potential for significant synergies leveraging complementary expertise in biophysical science (CA 1) and decision science, trade-off modelling and use of big data (CA 2). *The resubmission is persuasive with respect to the comparative advantage of WLE to work on the issues outlined in FP5, including thoughtful consideration of how WLE is different to conservation organizations. The nature of the technical relationship with FAO for CA 1 should be expanded on in the full proposal, bearing in mind that FAO is a very large organization with different departments and divisions with quite varied technical capacity. It will help the ISPC make a more informed judgment about this partnership if FAO's role can be described with more detail than has been*	annex on country integration activities in the proposal. Building on FAO's sustainability framework and indicators, and on WLE's Phase one Ecosystem and Resilience Framework (2014), FAO has agreed to collaborate with WLE-ESA, the relevant Agri-Food Systems CRPs and local partners to operationalizing the development of pragmatic scalable sustainability indices. This is at this stage with FAO's strategic program on "sustainable food and agriculture" (SFA), as confirmed by FAO in their endorsement letter in the proposal (see Annex 3.13), but will also include working with the relevant FAO country programs. In addition, there are also other areas of on-going cooperation between FAO and WLE on such things as wastewater management, gender, and the

ISPC Feedback & recommendations (Sept 29th, 2015)	Response in pre-proposal re-submission (January 15th, 2016)	ISPC feedback on re-submitted pre-proposal (February 5th, 2016)	Response in full proposal (March 31st 2016)
		possible in both the original pre-proposal and the resubmission.	initiative on agro-ecology for food security and nutrition.
"Among the proposed leadership team there is comprehensive expertise and good publications records, including staff from IWMI, WorldFish, CIAT, ICRISAT, ICARDA, IFPRI, ICRAF, CIFOR and Bioversity. There is also membership from universities and advanced research institutes e.g. Stanford, CIRAD and WUR, and international organizations UNESCO and IUCN. This plurality of partners with a leadership stake in WLE places a significant responsibility on the CRP Director to ensure that there is strong coordination and communication. It is something of a concern that the Director's position is currently under recruitment at such a crucial point, but a job description and person specification are included."	The **Governance and Management** sub-section has been revised to address the issues identified by the ISPC, namely to clarify WLE strengths on partnerships, and address the concerns on separating strategic leadership from operational management. As was discussed during the meeting in Rome, the governance structure of WLE had already scored highly in the IEA review of CRP governance last year, and other CRPs are adopting similar governance arrangements.	*Based on discussions with the ISPC in Rome, ISPC clarified that its assessment on governance and management was based more on issues around partnerships and strategic leadership rather than governance arrangements.*	The Governance and Management section is considered compliant with the guidance provided. In coordination with the WLE strategic partners, a new program director has recently been appointed, and will take up her role a few months before phase 2 is due to start. The partnership strategy has been revised and relationships between the Management Committee and Steering Committee, as well as the responsibilities of the Program Manager and the Program Director, have been clarified in response to comments from the IEA review.

Other Significant Changes in the Proposal	
Program revision based on budget envelopes	Following the formulation of the portfolio and subsequent allocation of budgets by program, the WLE phase 2 budget was revised downward by 30% from the original pre-proposal submission. Within these budget envelopes, and reflecting on the feedback from the ISPC (including the restructuring detailed above) and the IEA, and inputs from partners in the region, the budgets within the flagships and other elements of the program have been prioritized as detailed in the proposal budget and flagship narratives.
Program management costs	Program management and coordination have been re-designed and overall costs reduced significantly.
Other new areas within the program	Key new areas of emphasis in the proposal include: stronger linkages with the AFS CRPs on sustainability at scale; emphasis on soils and carbon sequestration; rural-urban linkages including urban food security; prominent system-wide Sustainability and Resilient Framework being co-developed with AFS CRPs; and continuing our strong partnership model with new partners, including RUAF, Global Resilience Partnership, SDSN, EAT Initiative and Future Earth and boundary partners in key integration locations.

3.13 PIM Calculations

Basis for contribution to SLO 1.1		
FP	**Contribution**	**Assumptions / Calculations**
RUL	National guidelines change in over 9m rural households' management practices	Although this policy work is carried out in several countries, the impact would again be highest in India. Among the rural population in India of about 876m capita or ca. 175m households about 25% have on-site sanitation systems (Bonu and Kim 2009, India Census 2011). Of these approx. 44 m rural households with septic tanks, we assume 20% will adopt after 6 years the national recommendations for nutrient recovery following the same RUL impact pathway 1 (policy advise) as above where WLE is facilitating in India but also in Sri Lanka and other countries the establishment of national septage use guidelines.
	[Uplift scenario] 0.5m irrigating farm households understand safer irrigation practices	WLE research will feed into capacity development efforts by WHO and FAO with national ministries in support of SDG 6.3 (RUL impact pathway 3). We are targeting to train every year 800-850 extension officers working in irrigated urban and peri-urban areas. With each officer in charge of up to 100 farmers, we can reach over 6 years about 500,000 farmers. The RoI in terms of averted DALY through investments in safe wastewater irrigation is 4.9 USD per dollar invested (Keraita et al. 2015).
VCR	6 million	The primary effort currently and in the nearest future – from water variability management perspective at least –focuses on the Ganges Basin. The rural population residing within the Ganges Basin in India and Bangladesh is estimated at 338 and 89 million respectively, or 67 and 18 million households. (*http://www.fao.org/nr/water/aquastat/basins/gbm/index.stm)* VCR approaches operate at large scale and can benefit population throughout the basin. If we assume a rate of adoption of VCR technologies of less than 10%, this translates into approximately 6 mill HH in total in two countries in the coming 6 years.
LWS	3 million	In the states of Karnataka, Maharashtra, Andhra Pradesh, Telengana Initiatives funded by CSR and state government initiatives for delivery of ALWM at scale – the population of rural land holders exceeds 150 m, with funded programs under LWS expected to reach conservatively 2% of these farmers to enable adoption of SLWM practices. In Ethiopia, large watershed investments by IFAD and Ethiopian government target 10m land-holders, LWS expects to influence 10% of these farmers to adopt SLWM.
RDL	3 million	RDL research will support programs and investments in restoration targeting adoption of restorative management practices. Restoration target of 6 million hectares, and pro rata basis of 1 household per 2 ha adopting restorative and climate relevant management practices as a result of the restoration, split across the countries listed above.

Basis for contribution to SLO 1.2		
FP	**Contribution**	**Assumptions / Calculations**
VCR	3 million	Phase 1 of WLE suggests that implementing flood capture and storage solutions in just one sub-basin (Ramganga) in the Ganges Basin would benefit 1.2 million inhabitants of 4 *dark* (groundwater overused) blocks by 2017. We estimate that over 6 years of WLE Phase 2 these solutions can be extended to benefit over to 2- times this number – approximately 3 million people - by extending the geography of such applications. This target is also related to the VCR contribution to SLO 1.1 above. Assuming that approximately 25% of the rural Ganges population is poor (Amarasinghe et al, 2016, in press), and that about 30 million people or 6 million HHs would participate and/ or benefit from the adoption of VCR approaches, we estimate that VCR could benefit around 7.5 million people. We estimate that slightly less than half would be assisted to exist poverty permanently as a result of VCR approaches through, amongst others, better access by the poor to flood water stored as groundwater for the dry season, reduced household losses and job creation, including by engaging with the Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA). In African basins and countries, a key VCR strategy to support poverty alleviation is through enhanced groundwater management for income generation and the alignment of national governments with water-energy-food nexus solutions that support the poor.
ESA	2.74 million	Calculations are based on the distribution of the ESA funding by country, with a focus on cross CRP and WLE focal region countries. We further considered the rural land mass of the country, and the size of the rural population and an efficiency ratio of 20%.
		Data from World Bank. Land mass calculations were (proportion of ESA budget by country) x (agricultural land surface of that country) x (20% of that area). Thus the scaling is by level of effort and resource allocations. The population number was calculated in a similar way: (proportion of ESA budget by country) x (rural population of that country) x (10% of that population).
		ESA estimates a 20% added value of its contribution to the targets established by other flagships and CRPs.

Basis for contribution to SLO3.1		
FP	**Contribution**	**Assumptions / Calculations**
RUL	Sustainable intensification with increased water and nutrient use efficiency supported on 4m ha of urban and peri-urban irrigated and rain-fed croplands.	Thebo et al (2014) calculated about 16.4m ha under irrigated and rainfed cropping within a ten km radius of areas in Latin America, SSA and South Asia. Using a 20 km radius, the area is multiplying. RUL will propose replicable models of farming system intensification for UPA to increase water and nutrient use efficiency on 25% of the 10 km radius area by working with its uptake partners RUAF and FAO and their networks (e.g. UCLG (United Cities and Local Governments); ICLEI-Local Governments for Sustainability; FAO's Food for Cities Programme) on the implementation of e.g. the Milan Urban Food Policy Pact which was drafted by RUAF and FAO and was signed by 100 cities at the Expo 2015. Evidence that similar research and policy work (RUL impact pathway 1) can be successful has been reported by WLE (Amerasinghe et al. 2012). This contribution targets efficiency increases "on farm" and has limited overlap with the below following contribution which increases nutrient and water use efficiency "across the food chain".
	Nutrient recovery from food waste reaches 10% of original NPK application in intervention areas, potentially benefitting e.g. 3.6m ha in India.	The RUL contribution will be achieved via resource recovery from septage (Nikiema et al. 2014); and supported for scaling via RUL's impact pathway 1 and 2 (investment and policy advice) and 4 (capacity development). We can improve nutrient use efficiency by returning otherwise lost nutrients back into the production cycle as fertilizer. Data from WLE Phase 1 (and e.g. Drangert 1998) verify that about 50% of the NPK in septage can be recovered via co-compost. Assuming a crop NPK uptake of 25-55% of the fertilizer application, and 30% food waste loss (FAO 2011), about 28% of the once applied crop nutrients reach the consumer. While 20-40% of this (mostly N) might get lost during excreta dewatering and 50% of the remaining C and N during composting, still 10% of the original NPK application can be recovered as ready-to-use fertilizer. Looking only at India, where the process is supported at scale via policy advise on fecal sludge management including RRR, and SDG related investments, the expected 12mt of organic waste (based on a 10% adoption rate, see below) would result in about 6m t co-compost. With an application rate of 10t/ha of this NPK enriched product, annually 0.6m ha could benefit, or over 6 years 3.6m ha. The support of organic matter application will also increase water holding capacity and water use efficiency (Heffer et al. 2015).

VCR	5% in target countries – water use efficiency	The VCR contribution will be achieved through large-scale policy change that inspires sustainable groundwater (GW) use for irrigation (through GRIPP initiative) – with a focus on Africa, where such use is currently low but potential exists. The aim is to realize at least 1% of the sub-Saharan Africa groundwater irrigation potential area over the period 2017–2022 (1% of this potential is estimated to be 500,000 ha of newly irrigated land, with 3.6 million rural and urban direct beneficiaries, with USD 1.2 billion of total investments leveraged over the above period [Altchenko and Villholth 2015]). Realization of sustainable groundwater management will increase water use efficiency in the region at least by 5% over current rainfed water management with low yield levels. Use of GW "on demand" generally is also more water use efficient than surface water use. While not estimated separately, nutrient use efficiency is expected to increase substantially for GW irrigated areas.
		Also targeting 10% of total associated water-energy-food nexus savings valued at a minimum at USD 2 billion across the Ganges, Nile, Volta and Mekong River Basins (leveraging many USD billion in planned infrastructure investments in these regions).
LWS	5% across 7.5m ha – water use efficiency	Improvement in efficiency of water delivery through main canal systems and improved on-field management in irrigated and rain-fed farming systems will enable 5% improvement of water use efficiency (water productivity) on over 7.5 million ha. Focal countries will be India, Pakistan and Egypt with extensive irrigation systems and increasing competition among water uses. Increasing water productivity (WUE) in East, South (targeting Ethiopia, and secondly Tanzania and Zimbabwe) and West Africa (targeting Ghana and secondly countries in Sahel) will focus on emerging small, medium and large irrigation and crop-livestock systems. Increased WUE in rainfed farming systems will be assessed in collaboration with relevant AFS. Basic target is to improve WUE and Nutrient efficiency on land managed by the households targeted in SLO 1.1 above.
RDL	5% across 6mn HA – water & nutrient use efficiency	5% improvement across 6 million ha for land restoration assumed as a product of the land restoration work. By restoring degraded land water and nutrient use efficiency will be increased, for example decreasing water run-off and decreasing nutrient losses in run-off and due to leaching.
ESA	5% across 1.6 million hectares	Calculations are based on the distribution of the ESA funding by country, with a focus on cross CRP and WLE focal region countries. We further considered the rural land mass of the country, and the size of the rural population and an efficiency ratio of 20%.

		Data from World Bank. Land mass calculations were (proportion of ESA budget by country) x (agricultural land surface of that country) x (20% of that area). Thus the scaling is by level of effort and resource allocations. The population number was calculated in a similar way: (proportion of ESA budget by country) x (rural population of that country) x (10% of that population).
		ESA estimates a 20% added value of its contribution to the targets established by other flagships and CRPs.

Basis for contribution to SLO3.2		
FP	**Contribution**	**Assumptions / Calculations**
RUL	2m t CO2e per year avoided through change from landfilling to composting	Reducing the amount of landfilled food waste and transforming it into compost helps to reduce GHG emissions, also through reduced fertilizer production (Favoino and Hogg 2008). Following mainly RUL impact pathway 1 (policy advise) we are working e.g. in India on national septage guidelines which will recommend options to reduce GHG emissions. With 0.215 tons of (excreta and other organic food) waste per capita and year in India, we assume a 10% success rate of the guidelines in terms of collection and composting, resulting annually in 12m tons of waste not ending on landfills. With 0.2 tons GHG per ton of waste, about 240,000 tons of CO_2-e can be prevented.
RDL	8m t CO2e per year sequestered in soil organic matter	Calculations were made using the CIAT-SOC App, which gives an estimate of the total increase of soil organic carbon in the top ~30 cm of the soil of altogether 11.175 t/ha; if the increase happens over a period of 25 years, that would equal an (**average**) annual sequestration rate of 0.447 t/ha (which is reasonable). If the total of 6,000,000 ha was brought under sequestration the very first year, that would sum up 67 Mt C (= 11.175 x 6 Mha), or 0.067 Gt C, or 0.246 Gt CO_2e. However more reasonable is if land is only **gradually** brought into this sequestration scheme then the total after 25 years would be 53.85 Mt C, or 0.054 Gt C, or 0.197 Gt CO_2e. Disregarding the dynamics of this process (more sequestration in early years and tapering off in later years) we divide the 0.197 Gt CO_2e by the 25 years. That would be **0.00790 Gt CO_2e/yr**. Countries where we expect to achieve this target are high priority for the German Soil Rehabilitation Initiative and possible climate financing under the 4 per 1000.

Basis for contribution to SLO 3.3		
FP	**Contribution**	**Assumptions / Calculations**
RDL	6 million ha	RDL is building evidence and enhancing capacity for governments, investors and local stakeholders to invest in, implement and monitor restoration interventions and climate relevant agricultural practices that build soil carbon. Based on a global lit review (McDonald and Shemie, 2014), a GIZ impact assessment supports (GIZ), and the Nairobi Water Fund business case (based on WOCAT database) we derived an overall estimate of **USD 150/ha** as the cost of implementing restoration practices. Thus to achieve 6 million ha restored will require investments of USD 900 million. We assume that developing the evidence base, capacity and partnership engagement to influence and support this level of investment will require a 5 - 10% up-front investment in research including on adoption, targeting, cost/benefit, monitoring and potential of restoration technologies.
ESA	1.6 million ha	Calculations are based on the distribution of the ESA funding by country, with a focus on cross CRP and WLE focal region countries. We further considered the rural land mass of the country, and the size of the rural population and an efficiency ratio of 20%.
		Data from World Bank. Land mass calculations were (proportion of ESA budget by country) x (agricultural land surface of that country) x (20% of that area). Thus the scaling is by level of effort and resource allocations. The population number was calculated in a similar way: (proportion of ESA budget by country) x (rural population of that country) x (10% of that population).
		ESA estimates a 20% added value of its contribution to the targets established by other flagships and CRPs.
LWS	Regenerated / reclaimed productivity of problem (saline, alkaline) soils in irrigation systems of minimum 0.1 million ha.	Improved management of irrigated saline, alkaline or waterlogged soils restores productivity of over 0.1 million ha. In Uzbekistan, 51% of 4.3 million ha is so badly salinized that yields of wheat and cotton are falling. A recent estimate of salt-affected lands in India is 141 million ha. LWS new knowledge on reclaiming soils will be effective for piloting on 0.1 million ha, i.e. less than 2% of affected soils in Uzbekistan, and/or less than 0.01% of India soils Improved management of irrigated saline, alkaline or waterlogged soils restores productivity of over 0.1 million ha. In Uzbekistan, 51% of 4.3 million ha is so badly salinized that yields of wheat and cotton are falling. A recent estimate of salt-affected lands in India is 141 million ha. LWS new knowledge on reclaiming soils will be effective for piloting on 0.1 million ha, i.e. less than 2% of affected soils in Uzbekistan, and/or less than 0.01% of India soils

3.14 Partner Endorsements

WLE has carried out a number of consultations with partner and stakeholders throughout the development of the Phase 2 proposal. During the development of individual flagships strategic partners were asked to provide inputs and support in its development. From March 7-18, 2016 WLE also held an open consultation.

As part of this Annex, below is a list of partners and stakeholders that provided inputs. Letters of endorsement are attached here as well.

Name	Organization	Relevant flagship	Comments/endorsement
Walter Engelberg, Head of Sector Project Desertification	GIZ	RDL	Mentioned in email that the RDL flagship is inspiring and hits the relevant points
Cynthia Rosenzweig, Carolyn Mutter and others	The Agricultural Model Inter-comparison and Improvement Project	RDL	Provided input to flagship narrative on role of AgMIP and AgMIP joined as partner
Norman Fenton	Queen Mary University of London	RDL/ESA	Provided input into RDL flagship and joined as partner
Walter Vegera	World Resources Institute	RDL	Letter of support and interested to be part of RDL program
Martti Esala	Natural Resources Institute Finland	RDL/ESA	Endorsed RDL program and being a partner
Rik van den Bosch	ISRIC - World Soil Information	RDL	Provided input into RDL flagship and joined as partner
Dr. ir. Marta Pérez-Soba, Lijbert Brussaard,	Wageningen University & Research Centre	RDL	Provided input into RDL flagship and interested to join as partner
Thierry Falcon	FAO	LWS	Provided specific feedback and support to the LWS Flagship
Dr Roelf Voortman and Max Merbis	Vrije Universiteit	LWS	Provided specific feedback and interested to join as partner
William's Daré	CIRAD	ESA/RUL	Provided specific feedback and interested to join as partner
Dr. Chris Neale	Water for Food Institute (WFI) at the University of Nebraska	LWS/VCR	Provided specific feedback and interested to join as partner

Letters of Endorsement

Name/Title	Organization	Related Flagship
Olcay Unver, Deputy Director, Land and Water Division	FAO	WLE Program
Ian Wright, Deputy Director General	ILRI	ESA, WLE Program
Robert Nasi, Deputy Director General	FTA, CIFOR	ESA, RDL, WLE Program
Bas Bouman, Director	GRISP, IRRI	LWS, ESA, WLE Program
Dr. Var Prasad, Director	Sustainable Intensification Innovation Laboratory	ESA, RDL
Marielle Dubbeling, Director	RUAF Foundation	RUL
Dr. Mark Smith Director, Global Water Program	IUCN	VCR
David Cleary, Director, Global Agriculture	The Nature Conservancy	RDL, ESA
Dr. Fritz Holzwarth, Rector	UNESCO-IHE	VCR, RDL, ESA, WLE Program
Anik Bhaduri, Director	Sustainable Water Futures Program (SWFP)	VCR
R. Quentin Grafton, Director	Food, Energy, Environment and Water (FE2W) Network	VCR/ESA

منظمة الأغذية والزراعة للأمم المتحدة | 联合国粮食及农业组织 | Food and Agriculture Organization of the United Nations | Organisation des Nations Unies pour l'alimentation et l'agriculture | Продовольственная и сельскохозяйственная организация Объединенных Наций | Organización de las Naciones Unidas para la Alimentación y la Agricultura

Viale delle Terme di Caracalla, 00153 Rome, Italy | Fax: +39 0657053152 | Tel: +39 0657051 | www.fao.org

Our Ref.: Your Ref.:

Rome, 29 March 2016

Dear Peter,

I am writing to confirm the intent to maintain FAOs continued involvement as a strategic partner with WLE in the second phase of its program. There are clear synergies between WLE and FAO's strategic program, especially between FAOs strategic program on "sustainable food and agriculture" (SFA) http://www.fao.org/sustainability/en/ and the WLE flagships on Enhancing Sustainability across Agricultural Systems (ESA); as well as between FAOs land and water-related work and the WLE flagship on Land and Water Solutions for Sustainable Intensification (LWS). Additionally, other areas of on-going cooperation between FAO and WLE exist on such issues as wastewater management, gender, and the initiative on agro-ecology for food security and nutrition.

Key areas for cooperation include engagement in global fora and processes, where WLE would support evidence based results relevant to delivering on our mission and mandate of food security and nutrition and sustainable agriculture. This will include co-hosting events and supporting specific activities at such events as the Stockholm World Water Week, EAT Food Forum, and HLPE-CFS processes. Another key area is engagement in specific countries for scaling food security and sustainable agriculture, especially where FAO priorities align with priority countries within WLE and the CGIAR more broadly. Additionally, FAO and WLE have jointly been contributing to IPBES ensuring that the critical contribution of agricultural ecosystems and their services contributing to SDGs are fully recognized and assessed.

Enhancing Sustainability across Agricultural Systems (ESA) Flagship

FAOs Common Vision for Sustainable Food and Agriculture balances the three dimensions of sustainability: economic, social and environmental. In light of FAOs experience and importance in supporting more productive and sustainable agricultural systems, I see an important connection with the ESA flagship and its work on SDG relevant sustainability indicators. While many productivity and sustainability indicators defined at farm level and for specific farming systems exist, creating and applying cross-sectoral indicators at multiple scales remains a critical challenge. Building on FAOs sustainability frameworks and indicators, and on WLEs Phase one Ecosystem and Resilience Framework

(2014), the partnership to help operationalizing the development of pragmatic scalable sustainability indices.

Land and Water Solutions for Sustainable Intensification (LWS) Flagship

The overall focus of the LWS flagship relates particularly well to FAOs work on land and water and the focus area on Efficient Resource Use within the SFA program. FAO will continue to work with LWS on specific activities, including scaling up such solutions in coordination with the FAO country land and water officers in specific countries.

We are looking forward to further develop these opportunities to continue the efforts between FAO and WLE.

Yours sincerely,

Olcay Unver
Deputy Director and Officer-in-Charge
Land and Water Division

Mr Peter G. McCornick
Deputy Director General-Research
International Water Management Institute
Water, Land and Ecosystems
CGIAR Research Program
PO Box 2075
Colombo
Sri Lanka

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

CGIAR

Our Ref: DDG-IS/Let/028/2016

14 January 2016

Peter McCornick
Deputy Director General - Research
IWMI

Dear Peter

We are writing to confirm our intent to continue developing our collaboration with WLE in the second phase proposals. This includes working with WLE and specifically the Enhancing Sustainability across Agricultural Systems (ESA) flagship to co-develop a sustainability framework as part of ESA AC1 'Operationalizing Sustainability Assessments at Scale'.

Explicit flagship links have been identified between WLE and the Livestock and Environment flagship, although there will be additional links through Feeds and Forages project 2. Possible co-funded activities include scoping studies and studentships local institutions, and to attract larger bi-lateral grants.

Collaborative research sites between Livestock and WLE that map to the CGIAR collaborative countries have been identified as: Vietnam, Tanzania, Uganda and Ethiopia.

We look forward to working more closely with WLE to identify more specific details and processes for our collaboration during the full proposal.

Yours Sincerely,

Dr. Iain A Wright
Deputy Director General – Integrated Sciences

Box 30709, Nairobi 00100 Kenya
Phone +254 20 422 3000
Fax +254 20 422 3001
Email ilri-kenya@cgiar.org

ilri.org
better lives through livestock

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ILRI has offices in:
Central America • East Africa
• South Asia • Southeast and East Asia
• Southern Africa • West Africa

office address: Jalan CIFOR, Situ Gede, Sindangbarang, Bogor 16680, Indonesia
mailing address: P.O. Box 0113 BOCBD, Bogor 16000, Indonesia
tel: +62 (251) 622 622, fax: +62 (251) 622 100, e-mail: cifor@cgiar.org, website: www.cifor.cgiar.org

Peter G. McCornick, Deputy Director General (Research)
International Water Management Institute

14 January 2016

Dear Peter,

We are writing to confirm our intent to continue developing our collaboration with WLE in the second phase proposals. This would include working with:

- The Enhancing Sustainability across Agricultural Systems (ESA) flagship to co-develop a sustainability framework as part of ESA AC1 'Operationalizing Sustainability Assessments at Scale'. The most logical link with FTA would be with our Landscape Dynamics, Productivity and Resilience.
- The flagship on Restoring Degraded Land (RDL) with possible co-funded activities include scoping studies and studentships local institutions, and to attract larger bi-lateral grants via the Centers involved: ICRAF, CIAT, CIFOR, Bioversity International, IFPRI, CIP. Given the recommendations from the ISPC and the decision not to pursue the development of a flagship on Forest Management and Restoration, the exact FTA component(s) (flagship or cluster of activity or cross-cutting area) with whom these actions would be developed.

Potential common geographies between FTA and WLE that map to the CGIAR collaborative countries have been identified as Vietnam, Burkina Faso and Ethiopia.

We look forward to working more closely with WLE to identify more specific details and processes for our collaboration during the development of the full proposal.

Robert Nasi
Deputy Director General - Research
Acting Director CGIAR Forests, Trees and Agroforestry
CIFOR

IRRI

Rice science for a better world
irri.org

14 January, 2016

Dear Peter McCornick,

I'm writing to confirm our intent to continue developing the collaboration between RICE ('GRiSP II') and WLE in the second phase proposals. This includes working with WLE and specifically the Enhancing Sustainability across Agricultural Systems (ESA) flagship to co-develop a sustainability framework as part of ESA AC1 'Operationalizing Sustainability Assessments at Scale'.

Explicit flagship links have been identified between WLE and RICE Flagship project 2: Sustainable farming systems for improved livelihoods. Possible co-funded activities include scoping studies and student scholarships, supporting local institutions, and attracting larger bi-lateral grants.

Collaborative research sites between RICE and WLE that map to the CGIAR collaborative countries have been identified as: India and Bangladesh.

I look forward to working more closely with WLE to identify more specific details and processes for our collaboration during the full proposal development.

Sincerely,

Bas Bouman,
Director, Global Rice Science Partnership (GRiSP)
International Rice Research Institute, Los Banos

International Rice Research Institute

IRRI is a member of the CGIAR Consortium

Mailing address DAPO Box 7777, 1301 Metro Manila, Philippines City and courier address Suite 1009, Security Bank Center, 6776 Ayala Avenue, 1226 Makati City, Philippines;
Tel. +63 (2) 856-6133, 856-6129; Fax. +63 (2) 891-1236 Headquarters at Los Baños Tel. +63 (2) 580-5600, 845-0563; Fax. +63 (2) 580-5699, 845-0606 Email: info@irri.org

Collaborative Research on Sustainable Intensification

Date: 14 March 2016

Dr. Deborah Bossio
Director, Soil Research Area
International Center for Tropical Agriculture (CIAT)
Regional Office for Africa
PO Box 823-00621
Nairobi, Kenya

Subject: Partnership between CGIAR Phase II Water, Land and Ecosystems Program and SIIL

Dear Dr. Deborah Bossio,

We are excited that your team is submitting a proposal for Phase II for the CGIAR – Water, Land and Ecosystems (LWE). Your proposal is in alignment with the goals and objectives of the Feed the Future Sustainable Intensification Innovation Lab (SIIL) being managed by Kansas State University and funded by USAID. The SIIL works towards sustainably improving productivity of smallholder farmers in Asia and Africa. We currently work in six countries (Senegal, Burkina Faso, Ethiopia, Tanzania, Bangladesh and Cambodia). The objectives and activities proposed in your project are of direct interest to the SIIL. We will particularly collaborate and work with your team on the following aspects:

1. We will share the sustainable indicator framework (this defines multiple indicators and metrics to measure impacts of SI across multiple scales as it relates to different domains such as productivity, environment, economics, social and human condition) which partners of SIIL are developing;
2. We will provide access to research sites and share information (for example in Bangladesh - which is working in polder communities looking into resource use efficiency, particularly water in rice ecosystems);
3. We will collaborate on aspects related to crop-livestock interaction, mixed cropping systems as they related to food and nutritional security (e.g. projects in Ethiopia, Tanzania, Burkina and Senegal); and
4. The Geospatial and Farming Systems Research Consortium funded by SIIL can collaborate on aspects related to using decision support and geospatial tools to map and assess impact of SI interventions.

This will be a great opportunity for all of us to work together and meet the goals and objectives of both programs. We look forward to this exciting partnership and collaboration between the two programs.

Sincerely,

P.V. Vara Prasad
Director, Sustainable Intensification Innovation Lab
Professor, Crop Ecophysiology
E-mail: vara@ksu.edu

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RUAF FOUNDATION
RESOURCE CENTRES ON URBAN AGRICULTURE & FOOD SECURITY

Water, Land and Ecosystems CGIAR Research Program
PO Box 2075, Colombo, Sri Lanka.

Attn: Peter G. McCornick, Deputy Director General-

PO Box 357, 3830 AK, Leusden
-The Netherlands
Tel: +31(0) 33 43 43 003
info@ruaf.org
www.ruaf.org
Reg. number: 32102434

Dear Mr McCornick:

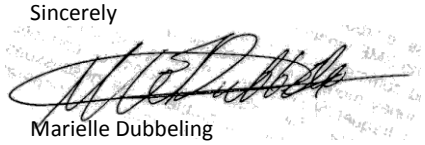
We are writing to confirm our interest and intent for the RUAF Foundation to continue our involvement as a strategic partner with WLE in the second phase of the WLE program.

RUAF has worked for more than a decade with different WLE partners (e.g. IWMI, FAO, CIAT) on urban food security and the facilitation of uptake and impact related to innovative research on urban and peri-urban agriculture including closed loop processes. We have been intimately involved in the design of the new RUL flagship for WLE Phase 2 and consider this partnership as very important as we, and our partners, depend in our work on high quality research and evidence based data for policy advice and programme innovations.

Key areas of our envisioned cooperation will include e.g. the implementation of replicable models of technical solutions for agricultural intensification in land and water constrained urban and peri-urban farming systems. RUAF will complement WLE's focus on business model development for instance with the facilitation of multi-stakeholder policy dialogue and outreach in collaboration with UCLG (United Cities and Local Governments) and ICLEI-Local Governments for Sustainability, as well as FAO's Food for Cities Programme. A particular uptake target will be the implementation of the Milan Urban Food Policy Pact which was facilitated by a technical team involving RUAF and signed in October last year by over hundred and twenty cities.

We are looking forward to further develop these opportunities and a fruitful collaboration with WLE in general and as co-lead of the RUL flagship in particular.

Sincerely



Marielle Dubbeling
Director RUAF Foundation

IUCN
Rue Mauverney 28
1196 Gland
Switzerland

Tel. +41 22 999 0000
Fax +41 22 999 0002
mail@iucn.org
www.iucn.org

Water, Land and Ecosystems CGIAR Research Program
PO Box 2075
Colombo
Sri Lanka

24 March 2016

Attn: Peter G. McCornick, Deputy Director General-Research, International Water Management Institute

Dear Peter:

We are writing to confirm our intention to continue involvement as a strategic partner with WLE in the second phase of the program.

IUCN has worked closely with WLE on a number of related areas, including water variability, wetlands management and landscape restoration. IUCN supports the work of WLE in convening agricultural research and understanding, and the need to better position this relative to conservation and development planning. Bringing this unique range of perspectives together helps to identify appropriate solutions.

IUCN has worldwide experience of effective support for the application of knowledge to changes in practice and policy in relation to water resources, landscapes and ecosystem services and management. Success depends on both incorporation of knowledge management and applications in research project design, but also facilitation of partnerships that empower key stakeholders and institutions to access research results, build needed capacities and negotiate applications.

We look forward to continued cooperation with the VCR Flagship on water, food, and energy issues to address competing water needs and nexus challenges. Our collaboration through WISE-UP to Climate in West and East Africa goes from strength to strength, and we look to collaborate further in the Southern Agricultural Growth Corridor of Tanzania.

We look forward to further developing these opportunities with WLE, and to continue the successful collaboration between IUCN and WLE.

Sincerely,

Dr Mark Smith
Director, Global Water Programme

Water, Land and Ecosystems CGIAR Research Program
PO Box 2075, Colombo, Sri Lanka.

Attn: Peter G. McCornick, Deputy Director General-Research, International Water Management Institute.

Dear Peter:

We are writing to confirm our intent for TNC to continue involvement as a strategic partner with WLE in the second phase of the program. TNC has been working closely with WLE on a number of areas related to landscape restoration, and land use planning for sustainable intensification in growth corridors in Africa. TNC sees WLE as bringing in the agriculture perspective to conservation and development planning, with a link to environmental services that is unique to the sector.

Key areas of cooperation include the working with the RDL Flagship on Water Funds, a public private partnership model to support improved landscape management that can effectively address water quality problems and farmer livelihoods, particularly in the Tana Basin where the Upper Tana Water Fund was launched last year. In addition, TNC is collaborating with ESA Flagship in support of sustainable intensification at scale through its work with the Southern Agriculture Growth Corridor of Tanzania (SAGCOT) where TNC and WLE together are providing land use planning expertise helping to improve the ecological and social sustainability of large scale investments. TNC is the lead partner in a WLE focal region project in Tanzania.

We are looking forward to further develop these opportunities to continue the efforts between TNC and WLE.

Yours sincerely

David Cleary

Director, Global Agriculture

Diretor, Agricultura Global

全球农业项目总监

Rectorate

UNESCO-IHE
Institute for Water Education

From
Dr. F.K. Holzwarth
T +31 15 215 17 01
E f.holzwarth@unesco-ihe.org

UNESCO-IHE
P.O. Box 3015
2601 DA Delft
Netherlands

Water, Land and Ecosystems CGIAR Research
Program
PO Box 2075
Colombo,
Sri Lanka.

Our reference
WSE-LWDFS/CFR/TMO

Date
March 29, 2016

Subject
Peter G. McCornick, Deputy Director General-Research, International Water Management Institute

Dear Mr. McCornick,

We are writing to confirm our intent for UNESCO-IHE to continue involvement as a strategic partner with WLE in the second phase of the program.

UNESCO-IHE has been involved in a number of important areas of work during WLE Phase 1. This includes helping to develop the Water Accounting + Online platform framework that provides consistent and coherent information on water resources and the services water provides, such as irrigation for agriculture, in a river basin or a country. In addition, we have been part of a number of WLE's Focal Region projects including one on understanding gender implications of agrarian change in Nepal, India and Bangladesh and supporting a water governance capacity development project in the Greater Mekong.

In Phase 2, we are pleased to continue the work on a number of areas including:

- Water Accounting, particularly how this can be used in key river basins such as Volta, Nile and Mekong
- Resource Recovery and Reuse – repackaging business models for use in curriculum development and contributing to water sanitation database
- Support to capacity development efforts including curriculum development for mid-career professionals and supervising/provision of post-docs for research in WLE.

We are looking forward to further develop these opportunities to continue the efforts between UNESCO-IHE and WLE.

Sincerely

Dr. Fritz K. Holzwarth
Rector a.i.

Postgraduate education, training
and capacity building in water,
environment and infrastructure

Visiting Address
UNESCO-IHE
Westvest 7
2611 AX Delft

T +31 15 215 17 15
F +31 15 212 29 21
E info@unesco-ihe.org
I www.unesco-ihe.org

International Secretariat
Sustainable Water Future Programme

Anik Bhaduri
Executive Director
a.bhaduri@griffith.edu.au
Phone: +61(0)7 37359272
Fax: +61(0)7 37357615
Australian Rivers Institute
Nathan Campus, Griffith University
170 Kessels Road
Nathan, Queensland 4111
Australia

Water, Land and Ecosystems
CGIAR Research Program
PO Box 2075, Colombo, Sri Lanka.

30.03.16, Brisbane,

Attn: Peter G. McCornick, Deputy Director General-Research, International Water Management Institute.

Dear Peter,

We are writing to confirm the interest of the Sustainable Water Futures Program (SWFP), a core project of Future Earth, to collaborate with Water Land Ecosystem (WLE) program in its second phase.

The SWFP is a global environmental program focusing on research, innovation and the science-policy interface on all issues related to water, building upon more than a decade of water-related research under the Global Water System Project, which has already collaborated with WLE Phase I.

The overall goals of SWFP and WLE phase II are similar: SWFP aims to assist in ensuring a balance between the needs of humankind and nature through the protection of ecosystems and the services it provides and to offer real solutions based on interdisciplinary science from all relevant stakeholders to deliver a sustainable 'water world.'

Key areas of cooperation include working with the VCR Flagship on the water, food and energy issues to address effectively competing for water uses and nexus challenges with a focus on the Mekong and on larger-scale water and related assessments.

We are looking forward to developing further these opportunities to continue the efforts between the SWFP and WLE.

Sincerely

Anik Bhaduri

Anik Bhaduri

International Secretariat
Sustainable Water Future Programme
Tel: +61(0)737359272 Fax: +61(0)737357615

United Nations Educational, Scientific and Cultural Organization
UNESCO Chair in Water Economics and Transboundary Water Governance
Australian National University

Australian National University

PROFESSOR R. QUENTIN GRAFTON FASSA
Professor of Economics and ANU Public Policy Fellow
Chairholder, UNESCO Chair in Water Economics & Transboundary Water Governance
Crawford School of Public Policy, Building # 132, Lennox Crossing, Acton ACT 2601, Australia

Telephone: +61 2 6125 6558
Facsimile: +61 2 6125-5570
Email: quentin.grafton@anu.edu.au

30 March 2016

Water, Land and Ecosystems CGIAR Research Program
PO Box 2075, Colombo, Sri Lanka.

Attn: Peter G. McCornick, Deputy Director General-Research, International Water Management Institute.

Dear Dr. McCornick:

I am writing to confirm the very strong interest of the Food, Energy, Environment and Water (FE^2W) Network to continue to collaborate with WLE.

The FE^2W (http://www.fe2wnetwork.org/) Network is a group of leading experts from universities, multilateral organisations and non-government organisations committed to addressing the world's food, energy, environment and water challenges. The FE^2W Network is working in six focus regions, including four where WLE has focused its efforts on in phase II: Ganges-Brahmaputra-Meghna Basin (South Asia), Mekong Basin (South-East Asia and China), Nile Basin (East Africa), Volta Basin (West Africa), Colorado Basin (North America), and the Murray-Darling Basin (Australia).

The goals of WLE and the FE^2W Network are complementary. FE^2W works with decision-makers to improve the understanding of systemic risks and how to manage shocks across these systems. Our approach is founded on collaboration and an emphasis on poverty reduction, sustainable livelihoods, and the need to maintain critical ecosystem services, opening ample room for collaboration.

Key areas of cooperation include working with the VCR Flagship on the food, energy and water nexus to effectively address competing water uses and challenges with a focus on the Ganges, Mekong and Nile river basins.

We are looking forward to further develop these opportunities between FE^2W and WLE.

Sincerely,

R. Quentin Grafton

3.15 Acronyms

3iE	International Initiative for Impact Evaluation
4GBP	Four Basin Gender Profile
A4NH	Agriculture for Nutrition and Health CRP
AB InBev	Anheuser-Busch InBev
ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AfDB	African Development Bank
ADPC	Asian Disaster Preparedness Center
AFOLU	Agriculture, forest and other land use
AFS	Agri-food System
AgMIP	The Agricultural Model Intercomparison and Improvement Project
AGRHYMET	Permanent Interstate Committee for Drought Control in the Sahel
ALWM	Agricultural Land and Water Management
ASARECA	Association for Strengthening Agricultural Research in Eastern and Central Asia
AVRDC	The World Vegetable Centre
AWLM	Agriculture Water and Land Management
AWM	Agricultural Water Management
BMGF	Bill and Melinda Gates Foundation
CA	Comprehensive Assessment of Water Management in Agriculture
CAADP	Comprehensive Africa Agriculture Development Program
CapDev	Capacity Development
CARE	Cooperative for Assistance and Relief Everywhere
CBD	Convention on Biological Diversity
CBO	Community Based Organization
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CCER	Center Commissioned External Review
CDIA	Cities Development Initiative for Asia
CFS	Committee on Food Security
CGCC	CGIAR Country Collaboration Countries
CGIAR	A global research partnership for a food-secure future
CGSpace	A Repository of Agricultural Research Outputs
CH4	Methane
CIAT	International Center for Tropical Agriculture
CIESIN	Center for International Earth Science Information Network
CIFOR	Centre for International Forestry Research

CIP	International Potato Center
CILSS	Comité permanent Inter-Etats de Lutte contre la Sécheresse dans le Sahel (Permanent Interstates Committee for Drought Control in the Sahel)
CIRAD	La recherche agronomique pour le développement (Agriculture Research for Development)
CLIPnet	CGIAR Consortium Legal/IP Network
CO2	Carbon dioxide
CoA	Cluster of Activities
CPWF	CGIAR Challenge Program on Water and Food
CRFS	City-Region Food Systems
CRP	CGIAR Research Program
CSA	Climate smart agriculture
CSE	Centre for Science and Environment (India)
CSIR-WRI	Council for Scientific and Industrial Research-Water Research Institute (Ghana)
CSV	Climate Smart Villages
CV	Curriculum vitae
DCL	Dryland Cereal and Legumes
DFID	Department for International Development
DGIS	Directorate-General for International Cooperation (Netherlands)
DMC	Disaster Management Center
EAT	Eat Initiative
EAWAG	Swiss Federal Institute of Aquatic Science and Technology
EAC	East African Community
ECOWAS	Economic Community of West African States
ELD	Economics of Land Degradation
EM-DAT	Emergency Events Database
ES	Ecosystem service
ESA	Enhancing Sustainability across Agricultural Systems (WLE Flagship Program)
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
ESR	Ecosystems Systems Resilience
ESS	Ecosystem services
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FE2W	Food, energy, Environment and Water (FE2W) Network
FL	Flagship Leader
FMARD	Federal Ministry of Agriculture and Rural Development

FP	Flagship Program
FTA	CGIAR Research Program on Forests, Trees and Agro-Forestry
GAAP	Gender Agricultural Assets Project
GCF	Green Climate Fund
GDP	Gross domestic product
GEF	Global Environment Facility
GEO	Group on Earth Observation
GHG	Greenhouse gas
GID	Gender and Inclusive Development (WLE Cross Cutting Theme)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLF	Global Landscape Forum
GMS	Greater Mekong Subregion
GPFLR	Global Partnership on Forest Landscape Restoration
GRIPP	Groundwater Solutions Initiative for Policy and Practice
GRiSP	Global Rice Science Partnership
GSF	Global Soils Forum
GWP	Global Water Partnership
IA	Intellectual Assets
IAH	International Association of Hydrogeologists
IAHS	The International Association of Hydrological Sciences
IASS	Institute for Advanced Sustainability Studies
ICAR	Indian Council for Agricultural Research
ICARDA	International Centre for Agricultural Research in Dry Areas
ICID	International Commission on Irrigation and Drainage
ICLEI	International Council for Local Environmental Initiatives
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICRP	Integrative CGIAR Research Program
ICSU	International Council for Science
ICT	Information and communications technology
iDE	International Development Enterprises
IDO	Intermediate development outcome
IDS	Institute of Development Studies
IEA	Independent Evaluation Arrangement
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center

IFI	International finance institution
IFPRI	International Food Policy Research Institute
IGAD	Intergovernmental Authority on Development (Horn of Africa)
IGRAC	International Groundwater Resources Assessment Centre
IIASA	International Institute for Applied Systems Analysis
IKG	Information and Knowledge Management Group
ILO	International Labor Organization
ILRI	International Livestock Research Institute
ILSSI	International Lab for Small Scale Irrigation
IMF	International Monetary Fund
INBAR	International Network for Bamboo and Rattan
INDC	Intended Nationally Determined Contributions
INRA	Institut national de la recherche agronomique (National Institute of Agricultural Research)
IP	Intellectual Property
IPBES	Intergovernmental Platform on Biodiversity and Ecosystem Services
IPES-Food	International Panel of Experts on Sustainable Food Systems
IPG	International Public Good
IRD	Institut de recherche pour le développment (Research Institute for Development)
IRRI	International Rice Research Institute
IsDB	Islamic Development Bank
ISIMIP	Inter-Sectoral Impact Model Intercomparison Project
ISP	Integrated Solutions and Policy Dialogue (formerly proposed WLE Flagship)
ISPC	CGIAR Independent Science and Partnership Council
ISRIC	International Soil Reference and Information Centre
IUCN	International Union for Conservation of Nature
IUWM	Integrated Urban Water Management
IWA	International Water Association
IWM	Institute of Water Modeling (Bangladesh)
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JRC	Joint Research Centre (The European Commission's in-house science service)
KM4CRPs	Knowledge Management for CRPs
KMC	Knowledge Management and Communication
LAC	Latin American and the Caribbean
LankdPKS	Land-Potential Knowledge System

LDN	Land degradation Neutrality
LSIS	Large Scale Irrigation Systems
LWP	Sustainably Increasing Land and Water Productivity (WLE Phase 1 program)
LWS	Land and Water Solutions for Sustainable Intensification (WLE Flagship Program)
M&E	Monitoring and Evaluation
MC	Management Committee
MEA	Millennium Ecosystem Assessment
MEL	Monitoring, Evaluation and Learning
MENA	Middle East and North Africa
MESH	Mapping Ecosystem Services and Human Well-Being
Mha	Million hectares
MOOC	Massive open online course
MoU	Memorandum of Understanding
MRC	Mekong River Commission
MRV	Managing Resource Variability
MUS	Multiple Use Water Services
N	Nitrogen
N2O	Nitrous oxide
NARS	National Agricultural Research Systems
NARES	National Agricultural Research and Extension Systems
NASA	The National Aeronautics and Space Administration (USA)
NatCap	Natural Capital Project
NBI	Nile Basin Initiative
NDC	Nationally Determined Contributions
NEPAD	New Partnership for Africa's Development
NGO	Non-governmental organization
NPK	Nitrogen, Phosphorous, and Potash (Potassium)
NRM	Natural Resource Management
NSF	National Science Foundation (USA)
OA	Open Access
OD	Open Data
OECD	Organization for Economic Cooperation and Development
P	Potassium
P&R	Planning and Reporting
PARC	Pakistan Agricultural Research Council
PES	Payment for ecosystem services

PIM	Policy Institutions and Markets CRP
PL	Project Leader
PLAAS	Institute for Poverty, Land and Agrarian Studies
POWB	Program of Work and Budget
PMU	Program Management Unit
PPP	Public-Private Partnerships
QMUL	Queen Mary University of London
R4D	Research for Development
RBM	Results-based management
RDL	Regenerating Degraded Landscapes (WLE Flagship Program)
RoI	Return on Investment
RRR	Resource Recovery and Reuse
RTB	Roots Tubers and Bananas CRP
RUAF	Resource Centers on Urban Agriculture and Food Security (Foundation)
RUL	Sustaining Rural-Urban Linkages (WLE Flagship Program)
SA	South Asia
SADC	Southern African Development Community
SAFA	for Sustainability Assessment of Food and Agriculture systems
SAGCOT	Southern Agricultural Growth Corridor of Tanzania
SC	Steering Committee
SDC	Swiss Development Cooperation
SDG	Sustainable Development Goals
SDSN	Sustainable Development Solutions Network
SEA	Southeast Asia
SEI	Stockholm Environment Institute
SI	Sustainable intensification
SIDA	Swedish International Development Cooperation
SLM	Sustainable Land Management
SLO	System-Level Outcome
SNV	Stichting Nederlandse Vrijwilligers (Foundation of Netherlands Volunteers)
SRF	Strategy and Results Framework (CGIAR)
SRI	System of Rice Intensification
SSA	Sub-Saharan Africa
SSP	Sanitation Safety Plan of the WHO
SuSanA	Sustainable Sanitation Alliance
SWAT	Soil and Water Assessment Tool

SWITCH	Sustainable Welfare Innovation and Competition in Health
TAAT	Technologies for African Agricultural Transformation
TATA	Tata Group, India
TBC	To be confirmed
TBD	To be decided
TEEB	The Economics of Ecosystems & Biodiversity
TNC	The Nature Conservancy
ToC	Theory of change
TSBF	Tropical Soil Biology and Fertility
UAV	Unmanned aerial vehicle
UCLG	United Cities and Local Governments
UDSM	University of Dar es Salaam
UN	United Nations
UN-DESA	United Nations Department of Economic and Social Affairs
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNEP	United Nations Environment Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCO-IHE	United Nations Educational, Scientific and Cultural Organization – Institute for Water Education
UNFCCC	United Nations Framework Convention for Climate Change
UN-Habitat	United Nations Human Settlements Program
UNICEF	United Nations Children's Fund
UN-INWEH	United Nations University Institute for Water, Environment and Health
UNISDR	United Nations International Strategy for Disaster Reduction
UNOOSA	United Nations Office for Outer Space Affairs
UNU	United Nations University
UN-Water	United Nations Inter-agency mechanism on all freshwater related issues, including sanitation
UPA	Urban and peri-urban agriculture
USAID	United States Agency for International Development
USD	United States Dollars
VBA	Volta Basin Authority
VCR	Managing Resource Variability, Risks and Competing Uses for Increased Resilience (WLE Flagship Program)
W1	Window 1 (funding)
W2	Window 2 (funding)

W3	Window 3 (funding)
W1&W2	Windows 1 and Windows 2 (funding)
WASCAL	West African Science Service Center on Climate Change and Adapted Land Use
WASH	Water, Sanitation and Hygiene
WB	World Bank
WBCSD	World Business Council for Sustainable Development
WFI	Water for Food Institute, University of Nebraska
WFP	World Food Program
WHO	World Health Organization
WLE	CGIAR Research Program on Water, Land and Ecosystems
WMO	World Meteorological Organization
WRC	Water Research Commission (Ghana)
WRI	World Resources Institute
WSP	Water and Sanitation Program of the World Bank
WUA	Water users' association
WUE	Water use efficiency
WUR	Wageningen University and Research Center
WWF	World Wildlife Fund
YPARD	Young Professionals for Agricultural Development

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3.17 CRP on Water, Land, and Ecosystems (WLE) for Phase 2 (2017-2022): Addendum to the Full Proposal Responding to ISPC Commentary dated 15 June 2016

1. Introduction

WLE appreciates the ISPC's thoughtful commentary on our full proposal for Phase 2, and is pleased to have an opportunity to respond. We are delighted that the ISPC has confirmed the critical importance of WLE to achieving the ambitious goals and grand challenges of the CGIAR Strategic Results Framework (SRF), especially for achieving SLO 3, *Improve natural resources and ecosystem services*. The commentary observes that "[t]he ambition of WLE is central to the SRF and IDOs. It addresses a grand challenge that underpins the entire CGIAR – it covers areas that have been under-invested by the CGIAR in the past". The ISPC recognizes the excellent progress WLE has made since its initial pre-proposal in developing its research agenda, highlighting among others "its potential role in providing a pathway to enhance delivery of the System as a whole", its alignment of research with global policy objectives, its selection of appropriate partners, and its Capacity Development strategy.

The commentary requests that WLE prepare an addendum to the proposal that responds to five key issues summarized on page 2 of the ISPC Commentary. For all five issues, ISPC is seeking clarification and further details to enable a full understanding of WLE's proposal. That is the subject of this document. ISPC has not asked for revisions; therefore, we have not made substantive changes to the text of the proposal, its budget or PIM information, except for editing for clarity and in a few cases, updating of information. We have also updated Annex 3.6 on linkages to other CRPs and have made minor revisions in the proposal text to improve its clarity. These are listed in the annex to this Addendum. In Section 2 below, we respond to each of the five key issues identified. For each key issue, we briefly explain our understanding of the concern raised, and then offer further clarification and information as well as specific actions we will take, as appropriate.

Incorporated within the five key issues, the ISPC's commentary offers a number of very useful observations and suggestions pertaining to the overall proposal and individual FPs. We have considered these carefully and our responses below address the major concerns raised. WLE will of course seriously consider all of the ISPC's suggestions during the detailed research planning process. While we have not been requested to respond to all detailed comments, in Section 3 we provide brief responses to three ISPC observations and one Consortium Office comment where we feel clarification is required. Section 4 offers a few concluding observations.

As observed in the ISPC's 16 June 2016 commentary on the overall portfolio (pages 9-10), the allocation of W1&W2 funding to individual CRP programs was "based on history rather than strategic on prioritization"; i.e. it was based on the most recent allocations of W2 funding and an equal allocation of present W1 funds across each proposed CRP, and not based on strategic priorities of the portfolio. The result for WLE is a relatively low level of W1/W2 funding for the size of the program. Recognizing this anomaly within the portfolio budget assumptions, in developing the WLE Phase 2 program we designed it based on the guidance provided by the CO and others on the overall size of the program. In addition to the ISPC comment, we note that across the portfolio, SLOs 1&2 account for 77% of the total estimated 6-year budget, while SLO3 (NRM) accounts for just 23%[6].We believe this is too low from a broader portfolio perspective and does pose serious challenges for WLE, as highlighted by the ISPC's comments on specific flagships. This could be addressed by adjusting the

[6] From "Contribution estimates from 1st submission of full proposals 22 April 2016" (Consortium Office). The data is drawn directly from Table A of the proposals.

overall allocation of W1 funds across the portfolio, but we recognize this is a matter for the System Council.

2. Responses to Key Highlighted Points

In the ISPC's commentary, two of the five main points are combined into one, with multiple supporting observations. In this response, we have followed the same approach and similarly combined our clarifications for these two highlighted points (the third and fourth in the ISPC commentary). In each case, we offer a brief statement of our interpretation and understanding of the issue followed by our response.

a) Further elucidation of the process of prioritization at the basis of the research agenda for the CRP, and how this affects the functional integration amongst FPs, and with the other AFS and GIP CRPs.

Interpretation:

This request constitutes the concluding statement in the ISPC's discussion of WLE's Theory of Change and Impact Pathway. Many of the observations are very positive, but the commentary also states: "Although the justification for the proposed activities has been bolstered in this final proposal relative to the pre-proposal, the means and justification for prioritizing activities in the FPs and CoAs is not sufficiently clear." Elsewhere, the commentary suggests that "there is no evidence that WLE will follow a phased process in improving cross-CRP collaboration and integration as recommended by the ISPC". Our understanding of this request is that the ISPC would like more clarity on how WLE sets its research priorities within and among its Flagship Programs (FPs) and with regard to its joint work with other AFS and GIP CRPs.

Response:

Process of prioritization. In developing the Phase 2 proposal, WLE undertook a multi-pronged process that informed the selection of research priorities and helped us to triangulate on issues that we believe are critical, including those highlighted in the IEA evaluation of Phase 1. We did not consider it feasible or cost-effective to set criteria *a priori* and then follow a scoring and screening process. The Results Based Management (RBM) system being introduced for Phase 2 (described in detail in Annex 3.5) will help us distinguish among the best investments across the program as we move through implementation. The process we have followed included:

- Assessment of the updated SRF (2016-2030) document and identification of WLE's comparative advantage to contribute to the SLOs, IDOs, indicators and grand challenges.
- Explicit assessment of potential contributions to the SDGs and to Paris Climate Agreement goals.
- Building on the lessons learned and progress of Phase 1, and particularly the feedback from the recent year-long IEA evaluation of WLE as well as feedback from the ISPC, the Consortium Office, and others.
- Holding extensive consultations, mainly in the four regions where WLE will focus its efforts (Ganges, Greater Mekong, Volta-Niger and Nile/East Africa). We held regional consultations and have regular discussions with internal and external partners in target countries. These include research organizations, international finance institutions (IFIs), river basin and other regional organizations, governments, and the private sector. Along with participating in high-profile events such as the Global Landscapes Forum, these consultations helped shape the program. In the regions and in cooperation with AFS CRPs, WLE has played a leading role in site integration

meetings, particularly in Ghana, Bangladesh and Nepal, and contributed to meetings in Vietnam, Ethiopia, Nigeria and India, as well as Laos. WLE's Enhancing Sustainability across Agricultural Systems (ESA) Flagship has built on these discussions along with AFS CRPs. For instance, work in the Mekong will focus on better understanding the impacts of upstream development on delta agro-ecosystems. In Ghana, the focus will be on improving dry season agriculture to adapt to climate change in a context of increasing variability in rainfall and streamflow.

- Consultations by each flagship, comprised discussions with both CGIAR and external partners on who would be involved in Phase 2, what research questions should be asked, and what outcomes and impacts we should try to achieve. This included intensive in-depth discussions with the leaders of other CRPs, as reflected in Annex 3.6 on linkages and site integration.

In essence, the WLE program for Phase 2 is demand-driven and based on strong partnerships (Annex 3.1 describes WLE's effective partnership network at local, national, regional and global levels). WLE has held intensive consultations with multiple partners; its scientists engage in policy discussions at the national level and participate in many international forums and consultations, especially around the SDGs and climate change, in order to be aligned with international priorities. WLE also has built on its scientists' knowledge of the cutting edge academic literature and gaps that WLE can productively fill. We focus on areas where we believe WLE has a strong comparative advantage— and where we do not have this but understand it is a critical domain, we have identified partners who do have the needed capacity.

At the program level, we prioritized issues critical to achieving the SDGs and CGIAR targets and "Grand Challenges", identifying areas where WLE can add value to the CGIAR portfolio as a whole and has a distinct comparative advantage. Our comparative advantage is based on our strong set of complementary research and development partners, our extensive network of country-based offices and relationships spanning farm to landscape and river basin scales, and our active participation in important global initiatives. We have built on previous accomplishments, and selected areas where WLE has significant potential to contribute to achieving social and economic equality, and to solving emerging natural resources management (NRM) challenges critical to sustainable intensification of agriculture that are not being addressed adequately by others. Examples of emerging priorities included in Phase 2 are an increased emphasis on soils and further development of research on the sustainability and dynamics of peri-urban agriculture and its value chain linkages. No others are working effectively at the landscape scale on these issues. WLE often acts as a catalyst to bring others together to solve complex problems; our work on resource recovery and reuse (RRR) business models is an example of this catalytic role.

Similarly, the program has increased its focus on sustainability at scale and reduced its previous prioritization of research on individual ecosystems and their services, following IEA and ISPC feedback. This will manifest itself through developing and applying indicators, including engaging with partners to further refine and apply SDG indicators and the linkages between them. At a breakout session of the CGIAR science leaders meeting on 16th June 2016, co-development, testing and application of a portfolio-wide sustainability framework and indicators by WLE with and by the AFS-CRPs was highlighted as being a very important planned activity.

Geographically, as shown in Annex 3.6, WLE prioritizes CGIAR integration countries in four regions (Greater Mekong Region, the Ganges, and East and West Africa) to capitalize on its well-established partner networks and convening power. These countries include Burkina Faso, Ghana and Nigeria; Ethiopia, Uganda and Tanzania; Bangladesh, India and Nepal; and Vietnam. While maintaining the linkages to our key partners in these regions, WLE has re-framed its research and impact pathways to

emphasize joint activities with the AFS CRPs, especially in integration sites, and has sharpened its focus on the agricultural dimensions of cross-sector dialogues.

Functional integration of WLE FPs. WLE believes that its four thematic FPs (RDL, LWS, RUL, VCR[7]), taken together and combined with the integrative work through the ESA FP, offer a comprehensive integrated program able to achieve significant outcomes and impacts and thus contribute substantially to the ambitious goals of the CGIAR portfolio as a whole. Each of the four thematic FPs addresses a critically important issue; and together they form a coherent integrated body of work. Addressing only one or two issues would compromise the Program's ability to deliver its overarching goals and hence would undermine its ability to contribute meaningfully to the SRF.

In Phase 2, WLE FPs will concentrate their work in integration sites where AFS and GIP CRPs also work, frequently through the same local and national partners. Depending on the project, in many cases this will involve direct collaboration among CRPs. In addition, although much of the work is organized and presented as projects or activities within specific FPs, there are multiple synergies among them. Some examples include:

- In the Greater Mekong and the Ganges regions, collaborative research involving the ESA, LWS, and VCR FPs, with the FISH, RICE and CCAFS CRPs, will address water-food-energy nexus issues that could not be done by one flagship or CRP alone. This involves integration of analysis of impacts of interventions upstream with field and community-level research on rice and fish production in the deltas (Vietnam and Bangladesh).

- In the Volta-Niger region, ESA activities are aligned with LWS and RUL projects around improving agricultural water management (especially in the dry season) and nutrient recycling to address climate variability and food security. This work is linked to Livestock and CCAFS activities.

- In East Africa (Uganda and Ethiopia) and India, ESA projects work with the RDL and LWS FPs on landscape restoration, soil carbon and decision-analysis, and introducing more effective water management practices.

WLE uses several mechanisms to ensure greater integration. WLE's management team, which includes the FP leaders, will prioritize identifying and implementing opportunities for integrated FP research where this will add significant value. In addition, WLE is proposing to use a write-shop process developed and successfully applied in the WLE Focal Regions in Phase 1 to better align flagship activities internally and across the WLE portfolio. The advantage of this process is that integration occurs at many levels – partnerships/outcomes, research questions, methodologies and site locations. Other mechanisms include on-line webinars to share lessons and experiences, and cross-cutting communities of practice.

Prioritization and integration with other CRPs. Annex 3.6 provides specific details regarding the phasing-in of planned collaborative research with both other GIP CRPs and AFS CRPs. They are also included in the proposals of those CRPs. WLE's main collaboration mode with other CRPs is to develop joint activities in key thematic areas and geographies, mainly the CGIAR target countries, to undertake scoping studies, and where there is real potential for progress, to develop joint proposals to implement the research as pilots and proof of concept, and scale up the results. This is a phasing

[7] Respectively, FP1 **R**egenerating **D**egraded **L**andscapes, FP2 **L**and and **W**ater **S**olutions for Sustainable Intensification, FP3 Sustaining **R**ural-**U**rban **L**inkages, and FP4 Managing Resource **V**ariability, Risks and **C**ompeting Uses for Increased **R**esilience.

process, and at the outset will primarily involve four AFS CRPs (RICE, FTA, Livestock and DCL[8]) with which WLE has developed specific integrated research plans. The ESA FP has been developed in consultation with AFS partners to work at larger scales, complementing and facilitating our initial partnerships.

In Phase 2, three WLE FPs will collaborate with CCAFS. RDL and LWS plan to collaborate with CCAFS on NRM practices, particularly soil organic carbon building practices, that enhance adaptation and reduce greenhouse gases (GHGs) for testing in CCAFS climate-smart villages; and to link with regional and national partners for climate change policy impact and scaling up climate smart agriculture interventions (largely in Africa). WLE's VCR Flagship will continue its strong links with CCAFS, rooted in years of productive collaboration in Phase 1. VCR will co-invest with CCAFS in developing and field testing landscape-based solutions for adapting to and mitigating water resources variability in agriculture, and co-developing scalable interventions (e.g. drought monitoring and pro-poor flood insurance) that use climate- and water-related information to manage climate-related risks (largely in South and Southeast Asia).

WLE will collaborate closely with PIM and CCAFS, particularly on landscapes, value chains and climate change. PIM's gender research is done at multiple levels, with a strong emphasis on issues such as equitable access to markets, information and NRM governance, and land tenure systems within shared landscapes. WLE's comparative advantage lies in integrating work at landscape and national levels with multi-disciplinary research on water, land, soils and biodiversity. Through LWS and WLE's Gender and Inclusive Development (GID) theme, we will work closely with PIM on irrigation, land tenure and water rights. A discussion was recently initiated on collaboration between PIM's CoA 2.1 (Agricultural Transformation and Rural Incomes) and WLE RUL's CoA 3.1 (City-Region Food Systems); this has been added to Annex 3.6 on inter-CRP linkages.

WLE's VCR Flagship is the primary vehicle for collaboration with the FISH CRP. The benefits of flooding (associated primarily with fisheries and agriculture) in large inland floodplains and deltaic systems, such as the Mekong Delta, may be an order of magnitude higher than annual costs of flood damage. Thus, management of variability needs to consider both the spatial distribution of costs and benefits as well as the need to avoid/ minimize damage and optimize the benefits. VCR will collaborate with the FISH CRP to examine the trade-offs of sustaining fisheries in different development options.

WLE and RICE's joint research activities are focused on the optimization of land and water resources at the field to landscape and polder levels in rice-based farming and aquaculture systems. Collaboration will be through site integration at common geographies in Asia's mega-deltas and coastal zones (in Bangladesh, Myanmar, and Vietnam). This builds on on-going collaboration between WLE and RICE, formerly the Global Rice Science Partnership, and national partners in these areas. It will particularly focus on:

- Supporting the delineation and mapping of domains for RICE technologies, particularly to incorporate drought, salt, or submergence-tolerant rice varieties, and improving water and rice management practices.

[8] We acknowledge that DCL, or L&DC as it is now called, is still under development and review. In developing this Addendum, we have continued to engage with the DCL team, as well as with other CRPs (e.g. FISH). If necessary, we will re-prioritize once the portfolio is finalized. For the purpose of the re-submission we have maintained the acronym DCL to refer to this CRP.

- Jointly analyzing and quantifying the impacts of agricultural water management solutions at larger spatial scales, such as irrigation systems or river deltas, and providing feedback for further improvement of such solutions by RICE.
- Strengthening the biophysical and socioeconomic sustainability of rice-based cropping systems, including provision of multiple ecosystem services, further developing WLE's sustainability framework for scaling up of RICE technologies, and expanding the ecosystem services of rice farms as measured using landscape-level indicators.

At the operational level, WLE, PIM, A4NH, and possibly MAIZE and WHEAT, led by CCAFS, are developing an online planning and reporting system called "Managing Agricultural Research for Learning and Outcomes" (MARLO). It will be operational at the end of 2016, ready for a 2017 start. It will be one system, reducing transactions costs for those that work on more than one CRP through standardization of nomenclature and concepts. Over time, this will allow for results and information to be aggregated at the SRF level. We have also proposed two joint reviews in several countries to look at the progress/ constraints of common integrative approaches work.

To conclude, it is important to understand that WLE's planned activities with other CRPs could not be done nearly as well by any single CRP by itself. Collaboration among CRPs brings together strong teams with complementary expertise and partners that together create a strong comparative advantage in solving critically important NRM problems affecting agricultural productivity.

b) Clarification of the focus of the CRP on facilitation versus science, accompanied by a description and clarification of the science, technology, and innovation agenda (particularly for FP1, FP2 and FP4).

Interpretation:

This request is elaborated in the section of the ISPC commentary providing an overall analysis of the full proposal's contribution to the overall CGIAR portfolio. We understand from this comment that the ISPC has the impression that WLE is reducing its science role in favor of emphasizing its facilitation role. The ISPC commentary questions whether WLE will provide "core science support" to the AFS CRPs in soil and water management and ecosystem impacts. Finally, the commentary also wonders whether "WLE aims to take the CGIAR far beyond the limited technical fields addressed by IWMI in the past". WLE is requested to provide some specific clarifications related to FPs 1 (RDL), 2 (LWS) and 4 (VCR).

Response:

Facilitation *and* science. ISPC has raised a concern about the program overly focusing on facilitation at the expense of science; however, we feel the proposal does demonstrate an appropriate and needed balance. We believe that our unique comparative advantage lies in the integration of *both* science and facilitation, with research applied along the entire impact pathway. Perhaps our attempt to respond to earlier comments and explain how we will achieve significant outcomes and long term impacts has overshadowed the explanation of the science that WLE will deliver. Here, it is critically important to unpack the elements of the ISPC comments.

To be effective, WLE must do cutting edge disciplinary biophysical and socioeconomic research plus translational interdisciplinary research, with a strong emphasis on feeding research results into national, regional and global multi-stakeholder dialogues and discourses and promoting incentive frameworks for uptake. These roles are critically important, complementary and necessary. WLE's

proven capacity to combine these roles through its multiple partnerships is the basis for our unique comparative advantage.

An example that shows how WLE's comparative advantage can be brought to bear on key NRM challenges is on India's national policy of subsidizing the purchase of solar pumps. While there are substantial potential benefits from replacing existing pumps with solar pumps, there is also a high likelihood that their widespread adoption under existing policies will exacerbate the depletion of India's aquifers through even greater over-pumping. The long term consequences would be catastrophic. Therefore, during Phase 1, through its LWS FP, WLE researchers stepped back from "normal" water management research and examined the water-energy-food production nexus from a sustainability perspective. Based on this, WLE scientists proposed policy solutions that would enable farmers to sell their surplus solar power to the electricity grid, thus creating incentives to limit pumping to what is strictly necessary and receiving an income for selling electricity. Several variations on this solution are being tested and/or implemented in at least two Indian states, as reported in WLE's 2014 and 2015 Annual Reports.

Science and innovation agenda. The ISPC requests clarification of WLE's "science, technology, and innovation agenda (particularly for FP1, FP2 and FP4". As amplification of the descriptions in the research questions and key outputs for each Cluster of Activities (CoA) in the proposal, we highlight here a few examples for each of the three Flagships mentioned.

WLE's program is distinguished from traditional farm-level technology research by its broader perspective from project level up to watersheds and landscapes. Rather than stopping at the identification of what will be the benefits and costs of an intervention at farm level, WLE asks what will be the implications for the sustainability of natural resources and ecosystem services as well as poverty reduction and achieving social equality if particular packages of technologies or management practices are implemented at scale. This is central to the science agenda. Further, WLE adapts or develops data, models and analytical decision-support tools that scientists, implementers and policy makers can use to answer these broader agro-ecological questions; identifies opportunities for cross-sectoral win-win solutions; and works with partners to identify and test innovative landscape- and watershed-level interventions. This work cannot be done through single-disciplinary research; it requires interdisciplinary research teams asking and answering research questions that cross-cut and often transcend single disciplinary paradigms. These points are illustrated with selected examples in the following FP-specific discussion.

FP1 (RDL). As noted in the proposal, WLE's CGIAR partners have developed a wide range of technologies for restoring degraded lands during decades of research on crop, soil, biodiversity, land and forest management in every region of the developing world. Restorative farming systems incorporate crop rotations, conservation agriculture, agro-ecological principles, and integration of trees, grasses and forests in production landscapes. The science and innovation agenda here is not to further refine specific technologies; rather, it is to identify which combinations of technologies and practices are most appropriate in given conditions as a basis for developing investment portfolios. We do this by assessing the benefits and costs of interventions at landscape level and modeling and quantifying on- and off-site ecosystem services impacts of various technology combinations. We prioritize overcoming barriers to adoption and implementation. Identifying these barriers and potential strategies to overcome them is an important RDL research topic. For example, working with the ESA FP, RDL will deploy advances in decision science to analyze the costs, benefits and risks associated with different intervention options, including social, economic and biophysical factors, from the perspective of different stakeholder groups.

RDL is working with partners from the conservation, development, and agricultural domains to develop ecosystem service models that facilitate trade-off analysis between restoration actions and multiple ecosystem services and yield; and which further articulate these outcomes as measures of human well-being. Testing the impacts of large-scale soil restoration actions on water quality and energy production will also continue in Phase 2.

In 2015, the CGIAR signed a MoU with three French scientific institutions to undertake research to support the *4 per 1000 Initiative*, promising to address the soil science questions and implementation issues to build soil carbon for food security and climate change mitigation. There is still controversy on the achievable amount of soil carbon storage, and on how to include soil carbon in measuring, reporting and verification to achieve investment/policy change. RDL will focus on critical research areas needed to support these initiatives, for example by measuring carbon, considering all the costs, benefits and risks in tropical systems, and evaluating the costs, benefits and risks of various carbon building innovations. The work will also include further advancing risk and outcome indicators, including hydrological and gender-disaggregated socioeconomic factors. With the CCAFS, Livestock, FTA and DCL CRPs, this work will advance our understanding of the long-term impact of various interventions on soil organic carbon, soil health and associated food security, food system resilience, and adaptation to climate change.

Finally, RDL will advance the science of land evaluation, and develop analytic techniques in association with new technologies such as Unmanned Aerial Vehicle (UAV)-based land and crop monitoring, digital soil mapping, and chlorophyll fluorescence as a measure of crop photosynthesis and near infrared spectroscopy as a measure of soil properties. This work supports agronomic and AFS CRP programs, for example MAIZE and cassava (with RTB). Emphasis will include further advancing risk and outcome indicators, including hydrological and gender-disaggregated socioeconomic factors. Under the Africa Soil Information Service, advances in soil-plant spectroscopy, remote sensing and machine learning are being combined in new ways that is changing the way soils agronomy is conducted, providing evidence- and risk-based high resolution information to stakeholders at different levels. The work on projection of land health risks is complementary to on-going global efforts to track land degradation and restoration, and will emphasize new probabilistic quantification of risk factors associated with land degradation, leading to new early warning indicators of whether land is on an improvement or degradation pathway.

FP2 (LWS). LWS will address the challenges of taking agricultural land and water management (ALWM) technologies to scale in both irrigated and rainfed systems. The research will document how communities and institutions implementing and investing in ALWM can sustain and benefit from such improvements at a landscape scale through enabling policy measures, improved investments, and capacity strengthening. Through CoA 2.1, LWS will develop scientific understanding, including new knowledge to support policy measures and investment opportunities, to sustainably scale out ALWM innovations in order to transform smallholder farming.

LWS will assess the opportunities and potential impacts of piloted technologies of today and emerging innovations of tomorrow, alongside social-institutional solutions in research projects that have contributed to, or are part of, the current LWS Flagship. These projects include the Comprehensive Assessment of Water Management in Agriculture, the IWMI-Tata Water Policy Research Program, IWMI's work on large-scale irrigation in Asia, and the AgWater Solutions project, which were identified by a 2015 SPIA study as promising and innovative for impact assessment.

In collaboration with AFS CRPs, LWS will co-develop research on ALWM technologies and solutions for sustainable intensification of small scale irrigation and poverty alleviation. Some of this work is

supported by the US government's Feed the Future[9]. Technologies such as ICT for smallholder farmers to help manage water and soil capital are also emerging as particularly promising to attain both water productivity gains and improved yields

Improving the performance of medium- and large-scale publicly managed irrigation systems is a long-standing challenge for local and global food systems. Through CoA 2.2, LWS will work on transforming their performance and unlocking potential **agro-ecosystem** services by applying business-like approaches to transform delivery of irrigation services. LWS will also develop and test innovative management approaches. We will further strengthen linkages with private sector actors (water user groups, agribusiness, and ICT providers) to address calls from national and international finance and planning agencies for more productive, equitable and sustainable irrigation services. The WHEAT, Livestock, and RICE CRPs have expressed strong interest in integrating better land and water management practices within specific value chains such as dry season seed and fodder production, and introducing new varieties acclimatized for tropical conditions as well as potentially profitable niche crops.

FP4 (VCR). Through CoA 4.1, VCR will co-design, together with CCAFS and the AFS CRPs, basin-wide and regional solutions to: 1) reduce agricultural losses due to floods and droughts; 2) enhance agricultural water availability though new sustainable approaches to water storage; and 3) increase the livelihood benefits that water storage provides. Some examples of the type of research to be undertaken include:

- Design of strategies/technologies/policies that simultaneously reduce damaging flood flows and enable sustainable expansion of groundwater use for irrigation, e.g. through managed aquifer recharge at times of flood flow (focus on the Ganges river basin [Bangladesh, India and Nepal] and Southeast Asia).
- Use of remote sensing to provide water resource managers with essential information needed for resource management during both floods and droughts. This will include alerts when crucial thresholds are reached. This work will be done in collaboration with the CGIAR Big Data and ICT Coordinating Platform (priority countries include Ghana, selected parts of East Africa, South and Southeast Asia).
- Co-design of flood and drought weather index insurance schemes that work for smallholder farmers to safeguard against flood and drought losses (focus on South and Southeast Asia).
- Moving beyond a single use (e.g. electricity production) to managing water storage reservoirs as features of the landscape that can provide local people (including those who may have been relocated as a consequence of dam construction) with a range of livelihood benefits (focus on West Africa [Ghana], East Africa [Nile] and Southeast Asia).
- Identification of areas most suitable for crops with various levels of drought tolerance (e.g. rice and wheat) and, in the case of rice, various levels of submergence tolerance (South Asia).

Through CoA 4.2 and working with AFS CRPs and other partners, VCR will carry out detailed studies and develop solutions for managing water allocation in the context of increasing competition and ever-more critical trade-offs. Some examples of the type of research to be undertaken include:

[9] Examples include the chameleon soil water sensor and the wetting front detector.

- Collaborating with the FISH CRP, identify and determine how best to minimize and manage water-related trade-offs between different sectors, such as those between hydropower and fisheries (Greater Mekong and Zambia).
- Develop management strategies/options for "portfolios" of grey and green infrastructure to achieve better outcomes for the multiple goals of poverty reduction, water-food-energy security, biodiversity conservation and climate resilience (Greater Mekong, Nile, Niger/Volta).
- Determine the water resource and food security implications of solar versus traditional energy development at basin and country scales (South Asia).
- Develop institutions that enhance the role of groundwater in reaching the SDGs and empower smallholder farmers (women and men) to manage groundwater and use it sustainably for their livelihoods and food security (sub-Saharan Africa).
- Identify and determine how to implement water-energy-food nexus solutions in those regions where win-win solutions are feasible (for example trading food and energy rather than water across the countries of the Eastern Nile, in the SADC region, and across Bangladesh-Nepal-India).
- In conjunction with the WHEAT, RICE and MAIZE CRPs, identify hotspots (competition, overdraft, pollution, energy variability) and 'sweet spots', where land, water and energy resources are conducive to sustainable intensification of relevant AFSs (South and Southeast Asia).

Response to comment on scope of technical expertise. First, we must emphasize that the lead center, IWMI, was never specialized on "limited technical fields"; its strength from its inception has been applying inter-disciplinary analysis to difficult water management challenges. IWMI has continuously evolved over the years to address the broader challenges related to water beyond irrigation.

Second, while IWMI's own strengths have expanded in recent years, the Institute is only one among several major CGIAR and non-CGIAR institutional partners in WLE. Therefore, WLE's comparative advantage does not rest on the capacities of any single institution; rather, its unique capacity is its partnerships with a diverse set of partners each bringing well-established skills across a wide range of natural resource issues, with the totality being far greater than the sum of its parts.

Third, WLE is not primarily in the business of doing narrowly-defined "technology" research. Other institutions have a stronger comparative advantage in researching how to improve the performance of technologies like drip irrigation systems and solar pumps, or inventing new water and soil management techniques. Further, WLE is not primarily focused on the performance of technologies and practices at field or farm level: that scale is the remit of the AFS CRPs and other technical research institutions. Rather, another aspect of WLE's comparative advantage – through its partnerships with institutions having multiple capacities – lies in its capacity to identify existing and emerging opportunities for synergies and innovations in different contexts at project, landscape, watershed and agro-ecological zone levels through inter-disciplinary contextual analysis. Technologies are embedded in and reproduced through their social-institutional-political-cultural-economic contexts; the challenge, as demonstrated in our earlier work, is to identify innovations that have the potential to sustainably and equitably increase the productivity of agro-ecological systems *as systems*, while minimizing their negative externalities and unintended consequences.

Put differently, *the solutions that WLE produces with partners involve a combination of existing and emerging new technologies, social-institutional-political-economic-ecological analyses, development of new data, tools and models to do these analyses and support decision-making in complex contexts, and engagement with investors, policy makers and others to facilitate scaling up and out.* These strengths are illustrated in WLE's recent 2015 Annual Report to the CGIAR. Where appropriate, WLE will continue to support the development and scaling of particular emerging technologies and practices that are especially relevant to our key impact pathways. Examples of the latter are solar pumps and wetting front indicators.

c) **The ISPC requests WLE to provide in the addendum details on the scientific expertise within the CRP on the issues of process and intermediation, as well as its comparative advantage in dealing with these issues.**

d) **Further information on the types of scientific knowledge and impact pathways that will inform the "influence agenda" and shape institutions, including an increased awareness of trade-offs and uncertainty across scales and priorities as part of the recognition of the complexity of systemic change should also be provided in an addendum or rewrite of relevant sections.**

Note: These requests, combined into one request on page 5 of the commentary, are presented as two separate bullets on page 2. Given their inter-connection, we provide a combined response here.

Interpretation:

The discussion of these points is under the headings, "Theory of Change and Impact Pathways", and "Crosscutting Issues" (the latter with subheadings on "Gender and youth" and "Enabling environment"). We agree that this constitutes a critically important set of issues revolving around both WLE's understanding of the kinds of scientific capacity and knowledge needed to promote positive changes given the complexity and uncertainty of agro-ecosystems, and whether WLE has the necessary scientific expertise to be confident of its comparative advantage. These points are raised in various forms in the comments on some FPs as well. Among other points made, the ISPC suggests reconsidering the Gender and Inclusive Development (GID) theme in favor of embedding social scientists in the FPs playing a central role in planning and executing research; and providing more detail on how WLE plans to deliver "impacts on a landscape scale". This is related to other comments such as a concern that the obstacles to change are not outlined clearly, that the proposal is not sufficiently clear on the specific actions WLE will take to achieve outcomes, and there is a "need to identify who the decision makers are". We believe this can be boiled down to explaining what is WLE's scientific capacity and knowledge to promote change given the complexity of agro-ecosystems; and providing more details on it strategy to facilitate such change, i.e. to operationalize its TOC.

Response:

Scientific expertise and knowledge, and WLE's comparative advantage in understanding and promoting change. WLE has a strong track record in analyzing the sociology and political economics of agro-ecosystem and NRM issues, identifying key partners and effective strategies to promote changes in policies and investments, and achieving significant outcomes. WLE through its partners has a deep pool of social and political scientists and institutional economists with well-recognized expertise. These include Alan Nicol, Diana Suhardiman, Barbara van Koppen, , Tushaar Shah, and Katharina Felgenhauer (IWMI); Nicoline de Hann (WLE-recruited); Claudia Ringler, Wei Zhang, and Ruth Meinzen-Dick (IFPRI); Ravic Nijbroek, Christophe Bene, and Guy Henry (CIAT); as well as expertise within our university partners, for example UNESCO-IHE (e.g. Margreet Zwarteveen). In addition, and equally important, WLE partners have demonstrated expertise in facilitating and implementing policy decisions, most notably through the co-leader of the RUL FP (RUAF Foundation) as well as the

following: the WLE-supported IWMI-Tata program in India (Tushaar Shah, IWMI), the WLE-Greater Mekong program (Kim Geheb, WLE-recruited), and the Nairobi Water Fund (Fred Kizito, CIAT). CVs for these scientists are available through Annex 3.7 of the WLE proposal.

WLE recognizes the need to further strengthen its expertise on the relevant processes and intermediation. To this end, WLE has increased its engagement with PIM, which will be a strong partner in Phase 2. As described in Annex 3.6, WLE through its RDL, LWS, VCR and especially ESA FPs, will engage closely with PIM, especially its Flagship 1 (Technological Innovation and Sustainable Intensification) and Flagship 5 (Governance of Natural Resources), which among other things will focus on the application of political economics across the portfolio. Ruth Meinzen-Dick, Alan Nicol and other WLE scientists are active in PIM's FP5. To further strengthen WLE's capacities, we have partnered with institutions with recognized expertise and experience in promoting change. These include UNESCO-IHE and Wageningen University, with specific complementary competencies in the discovery phase and capacity development, and the RUAF Foundation, Kilimo Trust and MetaMeta as examples of partnerships in the piloting and scaling out phase.

A specific example of jointly promoting change that is being piloted in in 2016 is an effort by PIM, A4NH, CCAFS and WLE to define a shared policy agenda and coordinate policy-oriented research during Phase 2 starting with Bangladesh and Ethiopia — site integration countries where these programs have significant engagement. The plan is to review key strategy documents for agricultural growth, nutrition, climate change, and water and land management, to identify the core actions envisaged and the policy implications of each. Putting these together will help us see where our potentially separate policy analysis should overlap, and what we should pursue jointly.

Annex 3.1 provides details on the large number of partnerships WLE has established, for example with IFIs such as IFAD, World Bank, and African and Asian Development Banks, international organizations such as FAO and other UN agencies, regional intergovernmental economic and political organizations such as SADC, NGOs, and government policy makers. WLE is pleased that the ISPC recognizes the strength of our partnership strategy, noting its "well-developed appreciation and understanding of the many and varied partner relationships, including linkages to regional and global policy initiatives" (page 6).

WLE's strengths in this area include a combination of experience in implementing excellent research, and facilitating the engagement of stakeholders with the implications and possible solutions to complex problems emerging from that research; a deep pool of excellent and highly respected social, economic and institutional scientists; an equally strong pool of people with demonstrated capacity to promote significant policy changes and investments, many with long-term engagement in the CGIAR priority countries; and strong and enduring partnerships with a wide spectrum of institutions. Together, these form the basis for WLE's considerable comparative advantage.

Operationalizing the TOC. The ISPC commentary raises this issue within its discussion supporting the concern regarding priority-setting and integration among FPs and with other CRPs. Although the ISPC did not require a specific response to this concern, WLE wishes to respond briefly. First, WLE builds on over a decade of experience with, and learning from, the use of Theory of Change (TOC) concepts and impact pathways. The Challenge Program on Water and Food was a pioneer in their use. Over time, we have become more proficient in developing and – more importantly – using our TOC as a roadmap to help us achieve outcome targets. The ISPC's comments on both WLE's Phase 2 pre-proposal and full proposal explicitly recognize this progress. We are well aware that promoting change in complex agro-ecological-social-political-economic systems is very challenging: not only is there inertia in such

complex systems, and serious risks of unintended consequences, but there are strong vested interests which resist change, or promote trajectories that may well accelerate degradation and social inequity.

But our experience also demonstrates that it is possible to make significant contributions to promoting positive reforms and innovations that have the potential to improve sustainability, productivity, and human-wellbeing. We do this through a number of strategies. Our effective communication and knowledge management strategy, as described in Annex 3.10, plays an important role. Our engagement with multiple partners, stakeholders, decision-makers, and others, is the most important strategy for promoting change. As explained in detail in our Partnership Strategy (Annex 3.1), we have built strong relationships with policy makers, development agencies, financial institutions, and others that gives us a place at the table and a voice on critical NRM issues.

Two recent examples of significant outcomes achieved by WLE are reported in the 2014 and 2015 Annual Reports to the CGIAR. Briefly, these are: 1) scaling up of improved sustainable land and water management policies and implementation strategies in Ethiopia; and 2) setting up of a Water Fund to promote sustainable management of watersheds in a Kenyan river basin.

Finally, as emphasized in WLE's Phase 2 proposal (pages 7-10), the TOC provides a conceptual framework which we view as a hypothesis on how we our research will lead to desirable outcomes and impacts. WLE will review the efficacy of this framework regularly and revise it as needed. Annex 3.5 explains WLE's results-based Monitoring, Evaluation and Learning (MEL) system. The MEL system will facilitate systematic assessment of our progress towards achieving our planned outcomes and impacts.

Implementing gender research. In response to the idea of reconsidering the GID theme and embedding a social scientist in each FP, Annex 3.3 of the proposal (Gender Annex) explains that WLE does indeed plan to embed a gender social scientist within each FP to ensure that gender, youth and poverty issues remain at the core of the research. The function of GID is to provide overall technical support, guidance and coherence on gender issues, lead the synthesizing of lessons learned from all of the FPs, and provide a focal point for portfolio-wide gender discussions which PIM will lead.

e) Elaborate upon the justification for prioritizing RUL in the CRP as well as a discussion of the comparative advantage of CGIAR in this area.

Interpretation:

This request is elaborated in the commentary on the Rural-Urban Linkages FP (FP3). The discussion states that WLE presents "a strong argument for the CGIAR to invest in peri-urban agriculture and the efficient use and re-cycling of resources in peri-urban contexts" – but then adds that "the justification for its prioritization in this CRP needs further explanation". It goes on to say that "a clear justification for prioritizing areas such as the development of 'foodshed' planning and the analysis of urban supply chains in the CRP work" is lacking. The paragraph concludes with the statement that "Likewise, the comparative advantage of the CGIAR in this field of work is not obvious". The ISPC recommends that WLE consider including livestock waste in its work. There are other comments in the discussion of RUL which we will take into consideration during the planning process.

Response:

We note the ISPC's very positive comments in its review of WLE's pre-proposal as well as the very positive IEA review of the RUL FP. In its review of the pre-proposal, among other comments, ISPC noted that this FP is "both more practical and more implementable" than other FPs, and several times reiterated its view that "CIAT and the lead center [IWMI] have a reasonable claim to have comparative

advantage on these issues [i.e. rural-urban food linkages] within the CGIAR". We understand the ISPC is seeking more clarification of the expansion of the RUL work in Phase 2.

WLE's inclusion of a flagship on Rural-Urban Linkages is a result of the growing importance of urban and peri-urban areas for the overall sustainability of agriculture and food systems, which has been stressed by a number of partners and by the ISPC itself. Rural and urban landscapes can no longer be treated separately; they are increasingly intertwined, and their effective sustainable management requires an integrated systems approach. The natural resources needed to feed growing cities and the management of related waste will be decisive for the future of agro-ecosystems in rapidly growing developing countries, especially those in South Asia and Sub-Saharan Africa; yet to date it is given little recognition in the CGIAR portfolio as a whole. In addition, the growing amount of untreated waste produced by rapidly urbanizing areas constitutes both a major threat to the long term sustainability of peri-urban and rural ecosystems and indeed to staying within the limits of the planetary nitrogen cycle, but also offers an opportunity to recycle wastes into fertilizer. This will be win-win, by reducing the footprint of chemical fertilizers while also minimizing the volume of untreated urban waste.

WLE has a clear comparative advantage among the CRPs in its focus on natural resources across scales, i.e. its application of a landscape perspective, which facilitates looking across commodities and sectors at solutions with minimal trade-offs. With urban centers being increasingly the focal point of resource consumption, poverty and ecosystem degradation, and powerful urban stakeholders making decisions on inter-sectoral resource allocations, it makes sense to give the sustainability of rural-urban linkages a significant weight within WLE. We are building on our extensive experience in resource recovery and reuse (RRR) developed over the past decade. This experience has been recognized by global awards and is in demand from major UN and development agencies. Therefore, we argue that urbanization-related challenges and opportunities need to be prioritized within the CGIAR to include more research on rural-urban linkages in the global South. The majority of the poor already live in urban spaces in many parts of the world, and in others will do so in the coming decade. Therefore, we consider it to be very important that the CGIAR develops more related expertise. The WLE-RUL partner network, e.g. with UN-Habitat, is well positioned to lead this endeavor.

The development of research around rural-urban food flows, food waste, and "foodsheds" (similar to watersheds) was suggested by our partners FAO and RUAF, as a first entry point into Rural-Urban Linkages. We also work jointly on methodologies which can also be applied in data-scarce environments, an under-studied territory so far. In collaboration with northern and southern universities having significant technical expertise, we are currently defining boundaries for urban regional food systems and analyzing strategies for increasing the resilience of urban food supplies. This research cuts across scales and commodity value chains, complementing what individual AFS CRPs do.

WLE plans to continue two key areas of emphasis from Phase 1: a) food waste as a resource for soil rehabilitation (supporting RDL), and b) rural-urban water competition and allocation (supporting the VCR flagship), including safe wastewater use. In both areas, the CGIAR can demonstrate a clear comparative advantage as a global leader based on our research output (e.g. safe wastewater irrigation and RRR business models, via IWMI, documented in over 100 publications; see http://www.iwmi.cgiar.org/issues/wastewater/publications), IEA feedback, our WHO advisory status, and our status as a key partner with expertise in the global South (CIAT, IWMI) in emerging research areas such as City Region Food Systems.

Finally, we fully accept the recommendation to consider livestock waste and as discussed in Annex 3.6, this is already contemplated in East Africa with the Livestock, and Agriculture for Health and Nutrition (A4HN) CRPs.

3. Responses to Other Comments

Response to ISPC comments on the ESA Flagship:

In its discussion of FP 5 (ESA), the ISPC commentary raises questions regarding the feasibility of this flagship, offering a combination of positive comments while expressing some concerns. It states that the TOC is key to understanding whether ESA will achieve its planned outcomes, based on a perception that it relies on intermediary organizations with a "weak delivery and impact record". ISPC agrees the ESA concept "should be mainstreamed through the CGIAR" but questions whether it is feasible for one "free standing FP". The commentary concludes by inviting WLE to address these concerns in its discussion of the types of scientific knowledge and impact pathways that will inform what ISPC refers to as its "influence agenda".

We agree that there is significant breadth to the work planned by ESA. Indeed, this reflects and responds to the overall ambition of the CGIAR SRF and the entire portfolio. However, ESA is not a "free standing FP". Rather, in developing Phase 2, considerable emphasis has been placed on closely linking ESA to the four thematic WLE FPs, as well as with specific AFS CRPs. Its role is to provide integrative tools and metrics that will permit testing impacts of innovations at scale. To accomplish this, ESA has already achieved two critical milestones: 1) it has assembled a network of interdisciplinary specialists and systems modelers specifically to develop these tools; and 2) it has negotiated direct partnerships with the RICE, DCL, FTA, and Livestock CRPs for joint collaboration on scaling questions. While these scaling questions can be interpreted as broad, they become very precise when focusing on AFS interventions in specific geographies (e.g. soil conservation practices in Ethiopia, small scale irrigation in Ghana and Burkina Faso, testing of new rice varieties in Vietnam). ESA will roll-out its work beginning with RICE and FTA. Locations selected by the Flagship prioritize those geographies that are in the site integration framework, and/or shared WLE and AFS landscapes, in order to leverage advances and partnerships made in Phase I of the CRP.

WLE does not agree that the ESA partners have a "weak delivery and impact record". As emphasized in the proposal, in Phase 2 ESA's main partners are the AFS CRPs which in turn have strong national and local partners. In addition, ESA will work closely with strong research institutions such as Hubbard Decision Research, Queen Mary University of London's Center for Development Research, and partners with strong scaling out capacities such as FAO and international finance institutions.

Response to comments on mobilizing scientists' time:

In several sections of the commentary, the ISPC seeks assurances that WLE will mobilize sufficient time from its top systems scientists. Clearly, the amount of scientists' time that is devoted to WLE work is a function of having adequate financial resources to pay the costs. In some cases, for example RDL, the key named scientists are dedicated full time to WLE through combinations of W1&2, W3 and bilateral funding. All RUL scientists are dedicated full time to WLE as all IWMI scientists working on its "Resource Recovery, Water Quality and Health" theme are by definition working on this FP. In other cases, core scientists (e.g. those leading FPs) will be allocated sufficient funds to spend a minimum of 20% of their time on WLE, mostly to provide intellectual leadership. This will be significantly increased where they also lead W3 and bilateral projects that are part of WLE.

Response to comment on budget:

On page 5, the ISPC commentary states that "the CRP amount indicated for 'Management & Support Cost' is 1.8% of the total budget. This is relatively small for such a complex program. Clarification on the amount of funds allocated to management and support within FPs is needed, as is a breakdown of the percentage of the budget allocated to fieldwork and primary data collection." Our response is as follows:

- First, the ratio of Management & Support Cost appears to have been incorrectly calculated. The proposed CRP budget totals $354,687,000, and the 6-years Management & Support Cost totals $11,015,000, which is 3.1% of the budget. IWMI has followed the CRP2 guidelines for categorizing Management & Support costs, with the inclusion of funding for CRP-level components of Monitoring, Evaluation and Learning and Communications and Knowledge Management. Wherever possible, costs specific to or directly associated with a FP have been included in the FP budget.
- Second, funding for approximately 0.4 FTE of a Senior Scientist position has been budgeted for site integration management through the ESA FP, to a total of $270,000 over 6-years.
- Finally, funding for the GID coordinator and a postdoctoral fellow has been budgeted partially into each FP, to a total of $400,000 over 6-years.

Response to Consortium Office comments on WLE's IA and OA/OD plans:

The Consortium Office provided very positive observations on WLE's intellectual assets (IA) management and its Open Access/Open Data (OA/OD) policies. WLE appreciates these observations, as well as the suggestions made to provide further clarifications, particularly on the reporting lines and budget allocation to OA/OD, which the CO considered this to be on the low side. To respond, our intent is to include OA/OD budgets in the bilateral projects at the same level as allocated in the W1/W2 budget (i.e. 3-5%). In regards to reporting lines, when working on WLE-related matters, staff from the lead center will be accountable to the WLE Management Committee and will work closely with the Operations Team. This arrangement worked well in Phase 1. In addition, for both areas, capacity development and networking between partner organizations will be implemented.

4. Conclusion

We trust that our responses to the five issues on which the ISPC requested clarification and details have fully addressed the concerns expressed. WLE will be happy to provide any further information that is required. We are very pleased that the ISPC has acknowledged the progress WLE has made since submitting its first pre-proposal. This progress is largely the result of our responding to the issues and questions posed by the ISPC, which have enabled us to develop a more coherent program that we believe will make significant contributions to achieving the SRF goals. As the ISPC commentary states, it is inconceivable that the CGIAR portfolio not include a strong research emphasis on water, land and ecosystems. The ISPC has made the case eloquently in the following paragraph from page 2 of the commentary:

> *The ambition of WLE is central to the SRF and IDOs. It addresses a grand challenge that underpins the entire CGIAR – it covers areas that have been under-invested by the CGIAR in the past. Therefore, it is appropriate that it is an integrating CRP. WLE responds to the intention behind the CGIAR reform process in trying to apply the best research to the world's emerging NRM problems. WLE is connecting to the world's leading scientists in high priority fields where the CGIAR has been largely absent in the past. As a GIP CRP, it takes seriously its intended role of providing a pathway to enhance delivery of the System as a whole into key policy areas in the WLE field.*

As described in the proposal and further emphasized in this Addendum, WLE is building strong partnerships with AFS and GIP CRPs, as well as with many partners outside the CGIAR. We see these partnerships as absolutely necessary and critically important if we are to achieve our planned outcomes and impacts; and as equally critical to enable the CGIAR's ambitious portfolio to deliver fully on its targets. WLE's program is highly integrated, with synergies and complementarities among its flagships, such that the whole program is greater than the sum of its parts. Therefore, it is very important to maintain the coherence and unity of WLE to enable it to achieve its planned outcomes and impacts.

WLE is building on its predecessor programs, especially its first phase, which gives us a head start in demonstrating significant outcomes in the next few years. We have also used the first phase to strengthen our expertise and research programs in several areas, for example gender analysis and the application of new decision-support models and tools. WLE is also addressing new challenges that have not been adequately addressed in the past, and is developing new partnerships to enhance its capacity to deliver on these promises. We are committed to work with all our partners effectively and efficiently to deliver on our planned outputs, outcomes and impacts.

Annex: List of Changes in the WLE Proposal

Main proposal text (volume 1)

No major revisions were made in the proposal. However, aside from minor editing, a few small changes were made to increase its clarity, as follows:

Page 14 (section 1.0.4): A paragraph has been added explaining the planned outcomes of WLE's gender research.

Page 27 (section 1.0.11): At the bottom of the page, we have updated a paragraph to say we have now fully complied with IEA recommendations to update terms of reference of all governance and management entities, and have also updated the Accountability and Responsibility Matrix.

On pages 49, 50, and 52 (section 2.1.1.6), we have made the planned outcomes of the RDL CoAs more explicit.

Page 103 (section 2.3.1.9): One additional sentence was added to emphasize RUL's planned gender outcomes.

Pages 116-117 (section 2.4.1.3): Clarified and strengthened the discussion of VCR's ToC.

Pages 122, 124 (section 2.4.1.6): Made minor improvements in how CoA 4.1 research questions are stated, and sharpened the CoA 4.2 research questions.

Annexes (volume 2)

Page 196: in Annex 3.4 on youth, we have strengthened the statement on planned outcomes.

Page 212: We have updated Template 3.6.1 in Annex 3.6 on linkages with other CRPs to include developments that have occurred since the original proposal was finalized. These are PIM-RUL, MAIZE-LWS and WHEAT-LWS activities.

We have updated Annex 3.7 on staffing to include additional social scientists.

3.18 WLE Proposal Cover Letter

21 July 2016

Prof. Margaret Gill
Chair, CGIAR Independent Science and Partnership Council
Rome

Dear Maggie,

Response to ISPC Commentary on the WLE Phase 2 full proposal

On behalf of the WLE partners, we are pleased to submit an Addendum to the full proposal for Phase 2 of the Water, Land and Ecosystem CRP that directly addresses the points raised by ISPC. The Addendum is attached separately to this letter and includes an annex listing the small modifications made in the proposal. The Addendum is also now included as Annex 3.17 of the proposal (in volume 2). This ensures that the clarifications requested are reflected in the text of the proposal as a final record in this concluding stage of the submission process.

We appreciate the ISPC's thoughtful commentary on the proposal, and are pleased that you confirm the critical importance of WLE to achieving the ambitious goals and grand challenges of the CGIAR Strategic Results Framework (SRF), and the progress that WLE has made since our initial pre-proposal in developing the program.

As recommended, we have taken note of all of the observations by the ISPC, and have prepared the Addendum to respond directly to the five key issues summarized on page 2 of your Commentary. We have also addressed a few other key points raised in the feedback which we felt are pertinent to enable a full understanding of WLE's proposal. We have not made substantive changes to the proposal, but have made corrections and clarifications as appropriate. In summary, we have added one new activity to Annex 3.6 (linkages with other CRPs); and, as part of our response to the ISPC's point on science expertise, have added several new CVs to Annex 3.7 to further demonstrate comparative advantage of the partnership. In addition, we have made a few clarifying revisions in parts of the proposal related to gender, impact pathways and outcomes.

In developing the second phase of WLE, we have aligned the program with the three goals of the CGIAR's Strategy and Results Framework (SRF), and included a strong focus on the role that sustainability considerations play as a necessary dimension in achieving these. As noted by the ISPC, WLE is an essential part of the overall CGIAR portfolio, and in coordination with other CRPs, WLE is critical for the portfolio to deliver on sustainability at scale, including contributing substantively to five of the high level CGIAR targets, and supporting countries' efforts to attain the related Sustainable Development Goals. WLE has been designed to contribute directly to achieving System Level Outcome (SLO) 3, "improving natural resource systems and ecosystem services" of the SRF. The program will also contribute substantively to SLO 1, "reduced poverty", as well as SLO 2 through achieving health and nutrition benefits from better processing and reuse of waste.

Reference is made here to the five points raised by the ISPC in its commentary on the WLE proposal. **First**, the ISPC requested more clarity on our priority-setting process within and among its Flagship Programs (FPs) and with regard to its joint work with other AFS and GIP CRPs. WLE followed a multi-pronged process of consultation and engagement that enabled us to triangulate on critical agricultural sustainability issues requiring further research to achieve the CGIAR's goals, and where we have a comparative advantage. The Addendum explains this process in detail, and provides further clarity on the functional integration among the five Flagship Programs and with the AFS and GIP CRPs.

Second, the ISPC commentary requests further clarity on WLE's balance between science and facilitation and clarification of its science and innovation agenda, especially for three specific FPs. It appears that our focus on explaining how we will achieve our outcomes and impacts in response to earlier comments may have somewhat obscured the critically important science agenda that is embedded as the foundation of WLE's work. We note that some of the reviewers' detailed comments explaining the background to this issue, for example a reference to "the limited technical fields addressed by IWMI in the past", imply an incomplete understanding of the capacities, not only of IWMI but of the WLE partnership. We have therefore used this opportunity to further explain in detail what we believe is our comparative advantage in research on sustainability of agro-ecosystems; and have tried to show that our unique strength lies in our integration of both world-class science research and very effective facilitation capacities along the impact pathways. These capacities, and proven track record, are the basis for our confidence that we can achieve our ambitious goals and contribute substantially to the impact of the overall CGIAR research portfolio.

The **third** point raised by the ISPC asks for more information on WLE's scientific expertise on "process and intermediation" and its comparative advantage on these issues. In the body of the commentary, this point is linked closely to the **fourth** point raised by the ISPC, requesting more details on its strategy to facilitate change and shape institutions, given the complexity of agro-ecosystems requiring difficult trade-offs. In other words, the ISPC has asked for more information on how we will operationalize our Theory of Change (TOC).

The Addendum offers an integrated response to these two points. In essence, we have provided more details on WLE's deep pool of experienced social science and facilitation expertise, referring to Annex 3.7 of the proposal; we have also added several additional social scientists' CVs to Annex 3.7. We also provide further details on those WLE partners from outside the CGIAR having strong track records in social science and facilitation. Further, WLE emphasizes the important roles of its communication and knowledge management, partnership, and capacity development strategies (on which the ISPC has commented positively). In addition, we have provided specific recent examples where WLE scientists have achieved significant outcomes. We emphasize that we consider our TOC to be a hypothesis, itself the subject of our research to validate and, as necessary, incorporate feedback as part of the program's adaptive management process.

The **fifth** point raised is a request to elaborate further the justification for the Rural Urban Linkages (RUL) FP, and WLE's comparative advantage in this area. We have noted the somewhat conflicting messages from the ISPC on this FP; in its review of the pre-proposal, the ISPC confirmed the importance of this topic, and WLE's strong comparative advantage to address the complex set of issues that form the core of this program. The Addendum provides a detailed, and we trust convincing, explanation of the increasingly critical importance of effective management, including recycling and reuse, of urban food and water waste, and the growing integration of rural and urban agro-ecosystems. While the threats from mismanagement of these cycles is real, the opportunities to increase the resilience of urban food supplies through a broader focus on rural-urban food flows, food waste, and "foodsheds", as well as converting urban

wastes into valuable resources that enhance rather than degrade rural and urban ecosystems, are also enormous. WLE has brought in partners from northern and southern universities having significant technical expertise to increase our capacities. We are currently defining boundaries for urban regional food systems and analyzing strategies for increasing the resilience of urban food supplies. WLE, with its set of unique partners from both within and outside the CGIAR, has a strong comparative advantage to make major contributions to this field.

Finally, the WLE Addendum responds selectively to a few other issues raised, even though no specific response was requested at this stage. These include further details on the important role and feasibility of the Enhancing Sustainability across Agricultural Systems (ESA) FP, and an assurance that WLE will indeed mobilize significant amounts of the time of the senior scientists. We have also provided a brief response to an issue raised by the Consortium Office on WLE's intellectual assets (IA) management and its open access/open data (OA/OD) policies.

As detailed in the WLE Addendum, we strongly agree with the ISPC's commentary on the overall portfolio on the allocation of W1&W2 funding to individual CRP programs being based on historical allocations rather than strategic priorities of the portfolio. We designed the WLE Phase 2 program based on agreed guidance on the overall funding envelope for the program, with consideration of the inherent ambition for WLE within the CGIAR SRF. The relatively low portion of W1/W2 funding does pose additional challenges for the WLE program. This observation also applies to the relatively low allocation of resources at the portfolio level to SLO 3 and the risk that selective prioritization of flagships by funders could undermine the integrity of both the programmatic construction and integrity of the overall portfolio, which is designed to achieve inter-CRP synergies and increase the likelihood that productivity and human well-being outcomes and impacts will be sustainable in the long term.

Finally, we would like to again thank you for ISPC's feedback and discussions throughout this process. These have been invaluable to the team developing the second phase of WLE. We greatly appreciate the significant efforts of ISPC and look forward to continuing to work with you as we operationalize the program.

Yours sincerely,

Jeremy Bird

Director General

Performance Indicator Matrix (PIM) Tables: WLE CRP

Contents

Table A- CRP Level: Contribution to 2022 CGIAR Targets

CGIAR Target	Target contribution	Unit of target	Amount Needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	Synergies with other CRP's/ Platforms (click Ctrl for multiple selection)
100 million more farm households have adopted improved varieties, breeds or trees, and / or improved management practices	21	million farm households	85,230,000	17	0	83	0	CCAFS, DCLAS, Fish, FTA, Livestock, Maize, PIM, Rice, Wheat
30 million people, of which 50% are women, assisted to exit poverty	5.74	million people	56,750,000	17	0	83	0	CCAFS, DCLAS, FTA, Livestock, Maize, Rice, Wheat
5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse	5	%	129,860,000	17	0	83	0	A4NH, CCAFS, DCLAS, Fish, FTA, Livestock, Maize, Rice, Wheat
Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO2-e yr-1 (5%) compared with business-as-usual scenario in 2022	0.01	Gt CO2e/yr	26,373,000	17	0	83	0	CCAFS, DCLAS, FTA, Livestock
55 million hectares (ha) degraded land area restored	7.7	millions of ha	45,460,000	17	0	83	0	CCAFS, DCLAS, Fish, FTA, Livestock
		Total	343,673,000					

Quantitative contribution to countries

SLO	Country	1.1. 100 million more farm household have adopted improved varieties, breeds or trees, and/or improved management practices	1.2. 30 million people of which 50% are women, assisted to exit poverty	3.1. 5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse	3.2. Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO2-e yr-1 (5%) compared with business-as usual scenario in 2022	3.3. 55 million hectares (ha) degraded land area restored
Aggregate quantitative contribution to SLO Targets 2022		21.00	5.74	24.07	0.01	7.70
Quantitative contribution by Country	India	12.50	3.70	9.31	0.0012	0.76
	Nepal	0.05	0.02	0.01	0.0002	0.01
	Bangladesh	2.75	0.71	0.91	0.0000	0.04
	Vietnam	0.00	0.24	1.24	0.0000	0.09
	Pakistan	0.00	0.00	0.15	0.0000	0.00
	Sri Lanka	0.55	0.00	0.28	0.0002	0.00
	Ethiopia	1.00	0.33	2.44	0.0020	1.29
	Kenya	0.50	0.00	1.35	0.0022	1.00
	Nigeria	0.000	0.00	0.38	0.0000	0.00
	Tanzania	0.55	0.14	1.60	0.0000	1.33
	Ghana	0.85	0.02	1.79	0.0002	1.06
	Zimbabwe	0.05	0.00	0.15	0.0000	0.00
	Zambia	0.00	0.00	0.30	0.0000	0.00
	Uganda	0.00	0.03	0.03	0.0000	0.03
	Burkina Faso	0.00	0.03	0.05	0.0000	0.05
	Senegal	0.00	0.00	0.30	0.0000	0.00

Table A. CRP Level: Contribution to the 2022 CGIAR Targets (continued)

SLO	Country	1.1. 100 million more farm household have adopted improved varieties, breeds or trees, and/or improved management practices	1.2. 30 million people of which 50% are women, assisted to exit poverty	3.1. 5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse	3.2. Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO2-e yr-1 (5%) compared with business-as usual scenario in 2022	3.3. 55 million hectares (ha) degraded land area restored
	Mali	0.00	0.00	0.08	0.0000	0.00
	Egypt	0.00	0.00	0.30	0.0000	0.00
	Colombia	0.50	0.00	1.40	0.0020	1.00
	Peru	0.50	0.00	1.30	0.0020	1.00
	Other countries	1.20	0.50	0.72	0.0000	0.05
Amount needed (US$)		85,230,000	56,750,000	129,860,000	26,373,000	45,460,000
W1+W2 (%)		17%	17%	17%	17%	17%
W3 (%)		0%	0%	0%	0%	0%
Bilateral (%)		83%	83%	83%	83%	83%
Other (%)		0%	0%	0%	0%	0%
Synergies with other CRPs		CCAFS, RAS, WHEAT, MAIZE, FISH, DCL, PIM, Livestock, FTA	FTA, DCL, Livestock, RICE, CCAFS MAIZE, WHEAT	CCAFS, Fish, Livestock, RICE, Wheat, Maize, FTA, DCL, A4NH	FTA, DCL, Livestock, CCAFS	FTA, Livestock, DCL, CCAFS, RAS

CGIAR Target: 100 million more farm households have adopted improved varieties, breeds or trees, and / or improved management practices

CGIAR Target countries	Other Country	Target contribution in country
India	_	12.5
Nepal	_	0.05
Bangladesh	_	2.75
OTHER	Sri Lanka	0.55
Ethiopia	_	1
Kenya	_	0.5
Tanzania	_	0.55
Ghana	_	0.85
OTHER	Zimbabwe	0.05
OTHER	Colombia	0.5
OTHER	Peru	0.5
REST OF THE WORLD	_	1.2

CGIAR Target: 30 million people, of which 50% are women, assisted to exit poverty

CGIAR Target countries	Other Country	Target contribution in country
India	_	3.7
Nepal	_	0.02
Bangladesh	_	0.71

Vietnam	_	0.24
Ethiopia	_	0.33
Tanzania	_	0.14
Ghana	_	0.02
Uganda	_	0.03
Burkina Faso	_	0.03
REST OF THE WORLD	_	0.5

CGIAR Target: 5% increase in water and nutrient (inorganic, biological) use efficiency in agro-ecosystems, including through recycling and reuse

CGIAR Target countries	Other Country	Target contribution in country
India	_	5
Nepal	_	5
Bangladesh	_	5
Vietnam	_	5
OTHER	Pakistan	5
OTHER	Sri Lanka	5
Ethiopia	_	5
Kenya	_	5
Nigeria	_	5
Tanzania	_	5
Ghana	_	5
OTHER	Zimbabwe	5
Zambia	_	5
Uganda	_	5

Burkina Faso	_	5
OTHER	Senegal	5
Mali	_	5
OTHER	Egypt, Arab Republic of	5
OTHER	Colombia	5
OTHER	Peru	5
REST OF THE WORLD	_	5

CGIAR Target: Reduce agriculturally-related greenhouse gas emissions by 0.2 Gt CO2-e yr-1 (5%) compared with business-as-usual scenario in 2022

CGIAR Target countries	Other Country	Target contribution in country
India	_	0.0012
Nepal	_	0.0002
OTHER	Sri Lanka	0.0002
Ethiopia	_	0.002
Kenya	_	0.0022
Ghana	_	0.0002
OTHER	Colombia	0.002
OTHER	Peru	0.002

CGIAR Target: 55 million hectares (ha) degraded land area restored

CGIAR Target countries	Other Country	Target contribution in country
India	_	0.76
Nepal	_	0.01
Bangladesh	_	0.04
Vietnam	_	0.09
Ethiopia	_	1.29
Kenya	_	1
Tanzania	_	1.33
Ghana	_	1.06
Uganda	_	0.03
Burkina Faso	_	0.05
OTHER	Colombia	1
OTHER	Peru	1
OTHER	Uzbekistan	0.05

FP1-Restoring Degraded Landscapes (RDL)

PIM Table B: Flagship level: outcomes by windows of funding

2022 outcome description	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services	33,085,130	17	0	83	0	5,624,472	0	27,460,658	0

Outcome 1.2: Climate financing, national strategies and programs in 3 countries invest in research based practices to build soil fertility and soil carbon, providing food security, adaptation and mitigation benefits	33,085,130	17	0	83	0	5,624,472	0	27,460,658	0
Outcome 1.3: Capacity of national partners enhanced leading to national, district, and regional agencies in 6 countries adopting recommended monitoring and verification frameworks	16,542,566	17	0	83	0	2,812,236	0	13,730,330	0
	82,712,826					14,061,180	0	68,651,646	0

PIM Table C: Flagship level: investments by sub-IDO's

Sub-IDO	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Land, water and forest degradation minimized and reversed	41,356,412	17	0	83	0	7,030,590	0	34,325,822	0
Increased genetic diversity of agricultural and associated landscapes	4,135,844	17	0	83	0	703,093	0	3,432,751	0
Increased resilience of agro-ecosystems and communities,	7,444,114	17	0	83	0	1,265,499	0	6,178,615	0

especially those including smallholders									
Reduced net greenhouse gas emissions from agriculture, forests and other forms of land use	6,616,539	17	0	83	0	1,124,812	0	5,491,727	0
Conducive agricultural policy environment	6,616,539	17	0	83	0	1,124,812	0	5,491,727	0
Enhanced institutional capacity of partner research organizations	8,271,689	17	0	83	0	1,406,187	0	6,865,502	0
Gender-equitable control of productive assets and resources	8,271,689	17	0	83	0	1,406,187	0	6,865,502	0
	82,712,826					14,061,180	0	68,651,646	0

PIM Table D: Flagship level: annual milestones table

Year	Milestone description	Means of verifying	For which outcomes
2018	Synthesis of factors affecting success and failure of restoration initiatives (enabling factors and incentive schemes) leading to recommendations for the design of new restoration initiatives	Synthesis publication. Integration of recommendations into restoration initiatives in target countries	Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services

Year	Milestone description	Means of verifying	For which outcomes
2018	Innovative investment packages and restoration pilots that implement incentives and enabling conditions for adoption of sustainable and equitable restoration interventions in progress in 5 countries	Knowledge products available. Government and stakeholder project design documents refer to knowledge products.	Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services
2019	Capacity of national partners enhanced to align priorities and collaborate between national, regional and global levels, and to apply research based evidence to improve planning, monitoring and evaluation	WLE capacity development reports	Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services
2020	New investments in land restoration drawing on WLE investment packages and recommendations in 3 countries.	National and other stakeholder planning documents refer to WLE investment packages and recommendations. Co-design of investments.	Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services
2020	Updated assessment of progress towards SDG15 of zero net land degradation available and used by stakeholders	Published report and evidence of use of guidelines in government and stakeholder planning and reporting documents	Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services

Year	Milestone description	Means of verifying	For which outcomes
2022	1) National and sub-national strategies for restoration aligned with SDG, LDN in 3 countries 2) 3 countries establish programs for land restoration on 3 million ha, that target adoption of restorative practices by 1.5 million farm households benefiting 10 million people at least half of whom are women and children, with improved ecosystem services, including a 5% increase in water and nutrient use efficiency in restored lands.	1) National strategy reports 2) National and stakeholder strategy papers and project documents. WLE monitoring reports.	Outcome 1.1: Governments, agencies, and local stakeholders invest in research based strategies and programs in 3 countries targeting adoption of restorative and preventative practices that enhance ecosystem services
2018	Methodological guides on estimating and measuring soil carbon for carbon trading, and for evaluating the benefits of soil ecosystem services, including for supporting landscape restoration and climate change mitigation	Decision support guides available including feedback from partners	Outcome 1.2: Climate financing, national strategies and programs in 3 countries invest in research based practices to build soil fertility and soil carbon, providing food security, adaptation and mitigation benefits
2018	Predictive models on the potential for soil carbon sequestration under differing management in tropical soils and landscapes available	Methodological guidelines available including feedback from partners	Outcome 1.2: Climate financing, national strategies and programs in 3 countries invest in research based practices to build soil fertility and soil carbon, providing food security, adaptation and mitigation benefits

Year	Milestone description	Means of verifying	For which outcomes
2019	Capacities of national partners and future science leaders to monitor and verify soil carbon stocks and measure soil health in land restoration and management projects developed	WLE capacity development reports	Outcome 1.2: Climate financing, national strategies and programs in 3 countries invest in research based practices to build soil fertility and soil carbon, providing food security, adaptation and mitigation benefits
2020	New investments in restorative and soil carbon building in drawing on WLE research and recommendations in 3 countries.	Government and stakeholder program and project documents and WLE capacity development reports.	Outcome 1.2: Climate financing, national strategies and programs in 3 countries invest in research based practices to build soil fertility and soil carbon, providing food security, adaptation and mitigation benefits
2022	In 3 countries: 1) National and sub-national strategies for soil health and soil carbon aligned with climate agendas (NDCs) 2) programs are established for soil restoration resulting in 3 million ha with climate-relevant restorative strategies with 5% reduction in greenhouse gas emissions on these lands 3) National, district agencies invest recommended monitoring and verification frameworks for soil organic carbon	Agency reports, MRV reports.	Outcome 1.2: Climate financing, national strategies and programs in 3 countries invest in research based practices to build soil fertility and soil carbon, providing food security, adaptation and mitigation benefits

Year	Milestone description	Means of verifying	For which outcomes
2018	Projected trends in key land degradation risks and intervention impacts on future land degradation burden and costs over the next 30 years with inputs from partners	Publication on land degradation risks including feedback from partners	Outcome 1.3: Capacity of national partners enhanced leading to national, district, and regional agencies in 6 countries adopting recommended monitoring and verification frameworks
2018	Monitoring framework and reporting guidelines for land restoration surveillance, and periodic reports on achievement, that includes flexible sampling and measurement protocols and tools for measuring land health changes	Surveillance and reporting guidelines available including feedback from partners	Outcome 1.3: Capacity of national partners enhanced leading to national, district, and regional agencies in 6 countries adopting recommended monitoring and verification frameworks
2019	Capacity developed in risk assessment and land health surveillance approaches in governments, restoration agencies, and local partners for cost-effective tracking of land restoration in 5 countries	WLE capacity development reports	Outcome 1.3: Capacity of national partners enhanced leading to national, district, and regional agencies in 6 countries adopting recommended monitoring and verification frameworks
2020	Updated assessment on land health risks and restoration monitoring methods and reports available and being used by stakeholders	Published risk assessment and monitoring reports and evidence of use of guidelines in government and stakeholder planning and reporting documents.	Outcome 1.3: Capacity of national partners enhanced leading to national, district, and regional agencies in 6 countries adopting recommended monitoring and verification frameworks

Year	Milestone description	Means of verifying	For which outcomes
2022	100 trained professionals applying RDL methods for targeting restoration options, risk assessment and monitoring and evaluating impacts in 6 countries.	National and stakeholder planning documents. WLE capacity development reports.	Outcome 1.3: Capacity of national partners enhanced leading to national, district, and regional agencies in 6 countries adopting recommended monitoring and verification frameworks

FP2-Land and Water Solutions for Sustainable Intensification (LWS)

PIM Table B: Flagship level: outcomes by windows of funding

2022 outcome description	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries	29,683,012	17	0	83	0	5,046,112	0	24,636,900	0
Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation	36,172,941	17	0	83	0	6,149,400	0	30,023,541	0

Outcome 2.3 Coordinated management of problem soils and waters implemented in irrigation systems with substantial areas of degraded soils	8,351,578	17	0	83	0	1,419,768	0	6,931,810	0
	74,207,531					12,615,280	0	61,592,251	0

PIM Table C: Flagship level: investments by sub-IDO's

Sub-IDO	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Reduced production risk	18,284,735	17	0	83	0	3,108,405	0	15,176,330	0
More productive and equitable management of natural resources	8,918,120	17	0	83	0	1,516,080	0	7,402,040	0
Agricultural systems diversified and intensified in ways that protect soils and water	7,349,389	17	0	83	0	1,249,396	0	6,099,993	0
Increased resilience of agro-ecosystems and communities, especially those including smallholders	15,241,010	17	0	83	0	2,590,972	0	12,650,038	0
Enhanced capacity to deal with climatic risks and extremes	6,530,263	17	0	83	0	1,110,145	0	5,420,118	0
Improved capacity of women and young people to participate in decision-making	8,979,112	17	0	83	0	1,526,449	0	7,452,663	0

Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	8,904,902	17	0	83	0	1,513,833	0	7,391,069	0
	74,207,531					12,615,280	0	61,592,251	0

PIM Table D: Flagship level: annual milestones table

Year	Milestone description	Means of verifying	For which outcomes
2018	Phase 2 LWS Baseline and benchmark indicator systems in ALWM agro-ecological landscapes	Investment project reports informed by new science baseline data focal landscapes	Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries
2018	Phase 1 LWS investment options refined and shared with public/private sector involvement in 2 countries	Workshop proceedings, analysis of decision process	Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries
2020	ALWM Investments and policy informed by LWS-LWP science ,tools and data to date with potential to benefit 1 million rural beneficiaries, approx. 30% of which are women	Citation indices, references research report	Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries

Year	Milestone description	Means of verifying	For which outcomes
2020	Phase 2 investment options refined and shared with public/private sector involvement in 2countries	Investment project reports informed by new science	Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries
2021	Phase 2 policy recommendations informed policy and investments in 2 countries	Workshop proceedings, analysis of decision process	Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries
2022	LWS informing investments enabling adoption of ALWM solutions targeting several million ha in WLE and AFS-CRP landscapes	Publications and data sets	Outcome 2.1: Evidence of LWS solutions and investment options informing policy, practice, and investments into smallholder ALWM, in 4 countries
2018	Synthesized knowledge on technical, management and policy "levers of change" to accelerate sustainable intensification triggers new opportunities to scale-up and out field/farm interventions	Publications	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation
2018	New approaches to irrigation service performance improvement developed and pilot applications initiated	Workshop reports, publications, and investment project designs	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation

Year	Milestone description	Means of verifying	For which outcomes
2019	Guidance manuals for improved irrigation service delivery prepared for adoption by investors in irrigation development and modernization	Training in use of guidelines for selected development finance organizations	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation
2020	Landscape scale solutions (including PPP, policy revisions) developed and tested in at least 3 AFS/WLE co-located agro-ecosystems	Policy updates published/gazette data on diagnostics and systems analysis tool developed and piloted	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation
2021	Demonstrations of solutions to enable replication in other locations	Investment project reports	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation
2021	Modernized irrigation management practices being disseminated to irrigation agencies and investors in irrigation sector, including 2 IFIs	Workshop proceedings	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation

Year	Milestone description	Means of verifying	For which outcomes
2022	LWS recommendations informing investments supporting over 3 million ha in improved WUE/WP	IFI project design papers.	Outcome 2.2 Adoption of sustainability considerations and management improvements into ALWM investments and revitalization, new-build investments for small, medium and large irrigation
2019	investment and management guidelines developed for regeneration of 'problem (saline-alkaline) soils affected by poor irrigation management	investment project designs	Outcome 2.3 Coordinated management of problem soils and waters implemented in irrigation systems with substantial areas of degraded soils
2022	LWS recommendations informing investments supporting over 0.5 million ha in improved	IFI project design papers.	Outcome 2.3 Coordinated management of problem soils and waters implemented in irrigation systems with substantial areas of degraded soils

FP3-Sustaining Rural-Urban Linkages (RUL)

PIM Table B: Flagship level: outcomes by windows of funding

2022 outcome description	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Outcome 3.1: Increased capacity and evidence for stakeholders and policy makers to implement UPA related policies and farming system innovations	12,269,018	17	0	83	0	2,085,733	0	10,183,285	0
Outcome 3.2: Increased business capacities in nutrient, water and energy recovery from domestic and agro-industrial waste for intensified (peri)urban food production	16,250,357	17	0	83	0	2,762,561	0	13,487,796	0
Outcome 3.3: Increased public investments and adoption of WLE policy advise on fecal matter management and environmental protection	16,250,357	17	0	83	0	2,762,561	0	13,487,796	0
	44,769,732					7,610,854	0	37,158,878	0

PIM Table C: Flagship level: investments by sub-IDO's

Sub-IDO	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Agricultural systems diversified and intensified in ways that protect soils and water	6,175,135	17	0	83	0	1,049,773	0	5,125,362	0
Conducive agricultural policy environment	6,093,884	17	0	83	0	1,035,960	0	5,057,924	0
Increased resilience of agro-ecosystems and communities, especially those including smallholders	7,109,531	17	0	83	0	1,208,620	0	5,900,911	0
Reduced net greenhouse gas emissions from agriculture, forests and other forms of land use	9,140,826	17	0	83	0	1,553,940	0	7,586,886	0
Improved water quality	8,125,178	17	0	83	0	1,381,280	0	6,743,898	0
Land, water and forest degradation minimized and reversed	8,125,178	17	0	83	0	1,381,280	0	6,743,898	0
	44,769,732					7,610,854	0	37,158,878	0

PIM Table D: Flagship level: annual milestones table

Year	Milestone description	Means of verifying	For which outcomes
2018	5 cities implement Milan Urban Food Policy Pact with WLE facilitation	Records by cities, ICLEI and UCLG	Outcome 3.1: Increased capacity and evidence for stakeholders and policy makers to implement UPA related policies and farming system innovations

Year	Milestone description	Means of verifying	For which outcomes
2020	10 more towns and cities implement Urban Food Policies or Strategies with WLE facilitation	Records by cities, ICLEI and UCLG	Outcome 3.1: Increased capacity and evidence for stakeholders and policy makers to implement UPA related policies and farming system innovations
2022	25 additional towns and cities have implemented urban food Policies or strategies with WLE facilitation	Records by cities, ICLEI and UCLG	Outcome 3.1: Increased capacity and evidence for stakeholders and policy makers to implement UPA related policies and farming system innovations
2018	Demand for first online RRR business courses comparable to other sector related courses	Records of independent course provider(s)	Outcome 3.2: Increased business capacities in nutrient, water and energy recovery from domestic and agro-industrial waste for intensified (peri)urban food production
2021	Response to RRR business courses results in multiplication of providers	Records of independent course providers feedback on follow-up by participants	Outcome 3.2: Increased business capacities in nutrient, water and energy recovery from domestic and agro-industrial waste for intensified (peri)urban food production
2017	Policy and/or Guidance documents drafted	National ministry information	Outcome 3.3: Increased public investments and adoption of WLE policy advise on fecal matter management and environmental protection

Year	Milestone description	Means of verifying	For which outcomes
2019	Policy and/or Guidance documents accepted by national ministry	National ministry information	Outcome 3.3: Increased public investments and adoption of WLE policy advise on fecal matter management and environmental protection
2020	Policy and/or Guidance documents accepted by national cabinet	National ministry gazette	Outcome 3.3: Increased public investments and adoption of WLE policy advise on fecal matter management and environmental protection
2022	Policy and/or Guidance documents financed and implemented	National Gov. information	Outcome 3.3: Increased public investments and adoption of WLE policy advise on fecal matter management and environmental protection

FP4-Managing Resource Variability, Risks and Competing Uses for Increasing Resilience (VCR)

PIM Table B: Flagship level: outcomes by windows of funding

2022 outcome description	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)

Outcome 4.1: Increased evidence for stake-holders and policy makers to implement WLE solutions that increase water supply for agricultural production, livelihoods and ecosystems, and that decrease economic and human losses from water variability extremes	19,643,021	17	0	83	0	3,339,314	0	16,303,707	0
Outcome 4.2: Increased public and private sector adoption of WLE policy advise on changes in water resource infrastructure planning and management, leading to enhanced ecosystem services and increased resilience	13,095,347	17	0	83	0	2,226,209	0	10,869,138	0
Outcome 4.3: Increased public investments into, and adoption of WLE policy advise on measures to reduce groundwater depletion and promote its sustainable use with associated increase in agricultural incomes	19,643,021	17	0	83	0	3,339,314	0	16,303,707	0
Outcome 4.4: Alignment of regional energy plans and food security initiatives with available water resources, leading to reduced production risks and increased resource use efficiency	13,095,347	17	0	83	0	2,226,209	0	10,869,138	0
	65,476,736					11,131,045	0	54,345,691	0

PIM Table C: Flagship level: investments by sub-IDO's

Sub-IDO	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Enhanced adaptive capacity to climate risks	13,095,347	17	0	83	0	2,226,209	0	10,869,138	0
Increased resilience of agro-ecosystems and communities, especially those including smallholders	19,643,021	17	0	83	0	3,339,314	0	16,303,707	0
More productive and equitable management of natural resources	16,369,184	17	0	83	0	2,782,761	0	13,586,423	0
Reduced production risk	9,821,510	17	0	83	0	1,669,657	0	8,151,853	0
Land, water and forest degradation minimized and reversed	6,547,674	17	0	83	0	1,113,105	0	5,434,569	0
	65,476,736					11,131,045	0	54,345,691	0

PIM Table D: Flagship level: annual milestones table

Year	Milestone description	Means of verifying	For which outcomes
2018	AFS operating in the Eastern Gangetic Plains use WLE insights on water variability management	Government and international statistics and reports, References to VCR research in donor, government and multilateral banks' publications data from global DRR networks and processes that monitor SDG and Sendai targets	Outcome 4.1: Increased evidence for stakeholders and policy makers to implement WLE solutions that increase water supply for agricultural production, livelihoods and ecosystems, and that decrease economic and human losses from water variability extremes
2020	Results from water variability field pilot experiments in the Ganges Basin and/or SE Asia are incorporated in Government investment plans in at least 2 target countries	Government and international statistics and reports, References to VCR research in donor, government and multilateral banks' publications data from global DRR networks and processes that monitor SDG and Sendai targets	Outcome 4.1: Increased evidence for stakeholders and policy makers to implement WLE solutions that increase water supply for agricultural production, livelihoods and ecosystems, and that decrease economic and human losses from water variability extremes
2022	Donors, Banks and Governments continue to invest in WLE landscape-based solutions to water variability in all 3 targeted countries, and recognize this research as sufficiently relevant and important to replicate / expand the applications of tools to other Regions	Government and international statistics and reports, References to VCR research in donor, government and multilateral banks' publications data from global DRR networks and processes that monitor SDG and Sendai targets	Outcome 4.1: Increased evidence for stakeholders and policy makers to implement WLE solutions that increase water supply for agricultural production, livelihoods and ecosystems, and that decrease economic and human losses from water variability extremes

Year	Milestone description	Means of verifying	For which outcomes
2018	Hydropower companies and basin agencies in four targeted countries in SEA, WA and EA incorporate Flagship policy and technical advice into water infrastructure planning and operations	Reported cases of reservoir operations that use VCR recommendations - from Banks' loans, HP companies' memoranda, ICOLD bulletins etc.	Outcome 4.2: Increased public and private sector adoption of WLE policy advise on changes in water resource infrastructure planning and management, leading to enhanced ecosystem services and increased resilience
2020	At least one multi-lateral Bank explicitly includes Flagship recommendations on enhanced water infrastructure management (i.e. with due consideration of gendered water-related ecosystem services maintenance) in its investment and loan policies	Reported cases of reservoir operations that use VCR recommendations - from Banks' loans, HP companies' memoranda, ICOLD bulletins etc.	Outcome 4.2: Increased public and private sector adoption of WLE policy advise on changes in water resource infrastructure planning and management, leading to enhanced ecosystem services and increased resilience
2022	Flagship policy and technical advice and recommendations on enhanced water infrastructure management are explicitly adopted by 2 multilateral banks, and evidence of the use of these recommendations is available in at least 10 countries in Africa and Asia.	Reported cases of reservoir operations that use VCR recommendations - from Banks' loans, HP companies' memoranda, ICOLD bulletins etc.	Outcome 4.2: Increased public and private sector adoption of WLE policy advise on changes in water resource infrastructure planning and management, leading to enhanced ecosystem services and increased resilience

Year	Milestone description	Means of verifying	For which outcomes
2018	Information on risks and opportunities associated with groundwater use is explicitly used in at least 2 key AFS production areas by governments of at least 4 countries from Sub-Saharan Africa and/or South Asia. AMCOW endorses WLE recommendations and targets for Groundwater use	Data from Ag Ministries, census data, FAO Aquastat updates, Global public data sets.	Outcome 4.3: Increased public investments into, and adoption of WLE policy advise on measures to reduce groundwater depletion and promote its sustainable use with associated increase in agricultural incomes
2020	Sustainable groundwater practices informed by WLE research are in every-day use by farmers in at least 3 countries of South Asia / South East Asia, and 10 countries in Sub-Saharan Africa.	Data from Ag Ministries, census data, FAO Aquastat updates, Global public data sets.	Outcome 4.3: Increased public investments into, and adoption of WLE policy advise on measures to reduce groundwater depletion and promote its sustainable use with associated increase in agricultural incomes
2022	Flagship policy and technical advice and recommendations on enhanced but sustainable groundwater use for irrigation are explicitly adopted by 2 multilateral banks, and routinely followed by entire SADC Region, and by all major AFS in South / South East Asia	Data from Ag Ministries, census data, FAO Aquastat updates, Global public data sets.	Outcome 4.3: Increased public investments into, and adoption of WLE policy advise on measures to reduce groundwater depletion and promote its sustainable use with associated increase in agricultural incomes

Year	Milestone description	Means of verifying	For which outcomes
2018	At least 2 AFS use WLE nexus policy advise to address production constraints in countries of the Nile and Mekong Basins	Documented data on Investments in nexus activities Indicators for reduced environmental degradation indicators reflecting reduced water, energy and food shortages indicators reflecting increased resource use efficiency increased number of inter-sectoral committees and dialogues Change in diversity and volume of fish species	Outcome 4.4: Alignment of regional energy plans and food security initiatives with available water resources, leading to reduced production risks and increased resource use efficiency
2020	Entire hydropower sector in the Mekong changes operations to accommodate benefits for multiple sectors Conjunctive Hydropower and Irrigation planning recommendations informed by the Flagship research, is adopted by at least one multi-lateral Bank	Documented data on Investments in nexus activities Indicators for reduced environmental degradation indicators reflecting reduced water, energy and food shortages indicators reflecting increased resource use efficiency increased number of inter-sectoral committees and dialogues Change in diversity and volume of fish species	Outcome 4.4: Alignment of regional energy plans and food security initiatives with available water resources, leading to reduced production risks and increased resource use efficiency
2022	Governments of all Nile and Mekong countries, and two multilateral development banks explicitly adopt Flagship recommendations to align renewable energy development plans with available water resources.	Documented data on Investments in nexus activities Indicators for reduced environmental degradation indicators reflecting reduced water, energy and food shortages indicators reflecting increased resource use efficiency increased number of inter-sectoral committees and dialogues Change in diversity and volume of fish species	Outcome 4.4: Alignment of regional energy plans and food security initiatives with available water resources, leading to reduced production risks and increased resource use efficiency

FP5-Enhancing Sustainability across Agricultural Systems (ESA)

PIM Table B: Flagship level: outcomes by windows of funding

2022 outcome description	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Outcome 5.1 Adoption of WLE sustainability indicators and frameworks by governments and the private sector.	15,301,075	16	0	84	0	2,448,172	0	12,852,903	0
Outcome 5.2 Increased governmental and private sector capacity to implement SAI practices and develop SI policy.	22,951,611	16	0	84	0	3,672,258	0	19,279,353	0
Outcome 5.3 Stakeholders are using decision support tools to identify interventions and options to improve management of resources	15,301,075	16	0	84	0	2,448,172	0	12,852,903	0
Outcome 5.4 Agricultural land, water, and ecosystem service productivity is equitably increased with particular attention to female farmers and youth.	22,951,612	16	0	84	0	3,672,258	0	19,279,354	0
	76,505,373					12,240,860	0	64,264,513	0

PIM Table C: Flagship level: investments by sub-IDO's

Sub-IDO	Amount needed ($)	W1+W2 (%)	W3 (%)	Bilateral (%)	Other (%)	W1+W2 (Amount)	W3 (Amount)	Bilateral (Amount)	Other (Amount)
Agricultural systems diversified and intensified in ways that protect soils and water	21,397,784	16	0	84	0	3,423,645	0	17,974,139	0
Enrichment of plant and animal biodiversity for multiple goods and services	17,116,218	16	0	84	0	2,738,595	0	14,377,623	0
Increased resilience of agro-ecosystems and communities, especially those including smallholders	21,397,785	16	0	84	0	3,423,646	0	17,974,139	0
Enhanced capacity to deal with climatic risks and extremes	8,553,084	16	0	84	0	1,368,493	0	7,184,591	0
More productive and equitable management of natural resources	8,040,502	16	0	84	0	1,286,480	0	6,754,022	0
	76,505,373					12,240,860	0	64,264,513	0

PIM Table D: Flagship level: annual milestones table

Year	Milestone description	Means of verifying	For which outcomes
2018	Indicator framework and assessment tool jointly developed with AFS/FAO/UNEP	The Framework and Tool with indicators integrated into AFS planning and RBM	Outcome 5.1 Adoption of WLE sustainability indicators and frameworks by governments and the private sector.
2020	6 countries are using the SI Framework and Tool in agricultural and environmental planning.	Planning records and SDG targets of national ministries have flagship developed scenarios and targets.	Outcome 5.1 Adoption of WLE sustainability indicators and frameworks by governments and the private sector.
2022	10 additional countries, and 2 global agreements use flagship outputs for setting and monitoring progress on sustainability targets.	Planning records and SDG targets of national ministries have flagship developed scenarios and targets.	Outcome 5.1 Adoption of WLE sustainability indicators and frameworks by governments and the private sector.
2018	MESH and DAI MOOC are online and in use by 6 countries. 6 solutions platforms supported by ESA	Automated tracking of MOOC utilization and distribution Documented solution platform composition and outputs	Outcome 5.2 Increased governmental and private sector capacity to implement SAI practices and develop SI policy.
2019	ESA decision support for sustainability and scaling embedded in global sustainability curricula including that of NARES with FAO/UNEP	Documented curricula, and independent evaluation of utilization	Outcome 5.2 Increased governmental and private sector capacity to implement SAI practices and develop SI policy.
2017	4 AFS co-develop and integrate sustainability assessment framework and tool	AFS planning and reporting documentation.	Outcome 5.3 Stakeholders are using decision support tools to identify interventions and options to improve management of resources
2019	2 additional AFS and 10 NARES, and 250 university scientists trained in WLE generated SAI Solutions	AFS planning and reporting documentation capacity building records.	Outcome 5.3 Stakeholders are using decision support tools to identify interventions and options to improve management of resources

Year	Milestone description	Means of verifying	For which outcomes
2020	50 NARES, and 1000 university scientists trained in WLE generated SAI Solutions	Independent evaluation	Outcome 5.3 Stakeholders are using decision support tools to identify interventions and options to improve management of resources
2022	100 NARES and national universities (5000 scientists) trained in WLE generated solutions for SAI of AFS	Independent evaluation	Outcome 5.3 Stakeholders are using decision support tools to identify interventions and options to improve management of resources
2017	SDG planning of 4 countries uses ESA developed scenarios, trade-off analysis, equity assessment tools	National SDG plans and targets with cross SDG referencing and reporting.	Outcome 5.4 Agricultural land, water, and ecosystem service productivity is equitably increased with particular attention to female farmers and youth.
2022	Ten countries are utilizing ESA developed scenarios, trade-off analysis and equity assessment tools in SDG M&E.	National SDG Reporting with demonstrated cross-SDG referring and reporting	Outcome 5.4 Agricultural land, water, and ecosystem service productivity is equitably increased with particular attention to female farmers and youth.