CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

LED BY: IWMI International Water Management Institute

2017 Annual Report:

CGIAR Research Program on Water, Land and Ecosystems (WLE)

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IN PARTNERSHIP WITH:

Bioversity International, CIFOR, CIAT, CIP, FAO, ICARDA, ICRISAT, IFPRI, ILRI, RUAF Foundation, World Agroforestry Centre, WorldFish

CGIAR Research Program on Water, Land and Ecosystem (WLE)

Connected Thinking, Compelling Solutions

WLE is a global research-for-development program connecting partners to deliver agricultural solutions that enhance our natural resources – and the people who rely on them. WLE brings together 11 CGIAR centers, the UN Food and Agriculture Organization (FAO), the RUAF Foundation, and numerous national, regional and international partners to find integrated solutions.

WLE is led by the International Water Management Institute (IWMI) and partners, and supported by CGIAR, a global research partnership for a food-secure future.

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ACRONYMS

4p1000	4 per 1000 Initiative
A4NH	CGIAR Research Program on Agriculture for Nutrition and Health
ACIAR	Australian Centre for International Agricultural Research
ADB	Asian Development Bank
AFR100	African Forest Landscape Restoration Initiative
AfSIS	Africa Soil Information Service (Project)
AICI	Agency Insurance Company India
ALWM	Agricultural Land and Water Management
ANU	Australian National University
AQUASTAT	Global Water Information System (FAO)
ATA	(Ethiopian) Agricultural Transformation Agency
Bioversity	Bioversity International
BMGF	Bill and Melinda Gates Foundation
BMZ	Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung
CASI	Conservation Agricultural Program (under CIMMYT)
CBA11	11th International Conference on Community-based Adaptation to Climate Change
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CEWAS	International Centre for Water Management Services
CIAT	International Center for Tropical Agriculture
CIFOR	Center for International Forestry Research
CIMMYT	International Maize and Wheat Improvement Center
CIPAV	Caisse interprofessionnelle de prévoyance et d'assurance vieillesse des professions liberals
COP	Conference of Parties (to a UN Convention)
CRFS	City Region Food Systems
CRP	CGIAR Research Program
ESA	Enhancing Sustainability Across Agricultural Systems (WLE Flagship Program)
EthioSIS	Ethiopia Soil Information System
FE2W	Food Energy Environment and Water
FISH	CGIAR Research Program on Fish
FTA	CGIAR Research Program on Forests, Trees and Agro-Forestry
GhaSIS	Ghana Soil Information System
GILIT	Gender in Irrigation Learning and Improvement Tool
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GLDC	CGIAR Research Program on Grain Legumes & Dryland Cereals
GMI	Groundwater Management Institute (under the SADC)
GRIPP	Groundwater Solutions Initiative for Policy and Practice
GYI	Gender, Youth and Inclusiveness
IA	Intellectual Assets
IAT	Integrated Assessment Tool
IBFI	Index Based Flood Insurance
ICAR	Indian Centre for Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas
ICID	International Commission on Irrigation and Drainage

ICLEI	Local Governments for Sustainability
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICSU	International Council for Science
IFAD	International Fund for Agricultural Development
IFI	International Finance Institution
IFPRI	International Food Policy Research Institute
ILSSI	Innovation Lab for Small Scale Irrigation
IMPACT	International Model for Policy Analysis of Agricultural Commodities and Trade
IWMI	International Water Management Institute
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
ISC	Independent Steering Committee
KMC	Knowledge Management and Communications
LDN	Land Degradation Neutrality
Livestock	CGIAR Research Program on Livestock
LWS	Land and Water Solutions for Sustainable Intensification (WLE Flagship Program)
MAIZE	CGIAR Research Program on Maize
MARIS	Migration, Agriculture and Resilience: Initiative for Sustainability
MELIA	Monitoring, Evaluation, Impact Assessment and Learning
MENA	Middle East and North Africa
MOOC	Massive open online course
NARES	National Agricultural Research Extension Systems
NBS	Nature Based Solutions
NGO	Nongovernmental Organizations
NiSIS	Nigeria Soil Information System
PIM	CGIAR Research Program on Policies, Institutions and Markets
PPP	Private-public-partnership
RDL	Regenerating Degaraded Landscapes (WLE Flagship Program)
RICE	CGIAR Research Program on Rice
ROAD	Risks and Options Assessment for Decision-Making Process
RRR	Resource Recovery and Reuse (Program under RUL)
RUAF	Ruaf Foundation
RUL	Sustaining Rural-Urban Linkages (WLE Flagship Program)
SADC	Southern African Development Community
SADMS	South Asian Drought Monitoring System
SAL	Sustainable Amazonian Landscapes project
SANDEC	Department Sanitation, Water and Solid Waste for Development
SDGs	Sustainable Development Goals
SINCHI	Sinchi Amazonic Institute of Scientific Research
SLMP	Sustainable Land Management Program
SLO	System Level Outcomes
SRE	Satellite Rainfall Estimate
SSA	Sub-Saharan Africa
Sub-IDO	Sub Intermediate Development Goals
TanSIS	Tanzania Soil Information System

UN-SPIDER	United Nations Space-based Information for Disaster Management and Emergency Response
UNAMAZ	Asociación de Universidades Amazónicas
UNCCD	United Nations Convention to Combat Desertification
UNFCCC	United Nations Framework Convention on Climate Change
UNE	United Nations Environment
UPA	Urban and Peri-Urban Agriculture
UTFI	Underground Taming of Floods for Irrigation
VCR	Managing Resource Variability, Risks and Competing Uses for Increased Resilience (WLE Flagship Program)
WHEAT	CGIAR Research Program on Wheat
WHO	World Health Organization
WISE-UP	Water Infrastructure Solutions from Ecosystem Services Underpinning Climate Resilience Policies and Programmes
ZEF	Center for Research and Development (University of Bonn)

Executive Summary

WLE responds to the growing challenge of natural resource scarcity and degradation of ecosystem services, and is linked to several SDG 2030 targets. In response to these 'intractable challenges', WLE works to identify more sustainable and equitable agricultural and natural resource management solutions. This is an ambitious and wide-ranging agenda, but a vital one: scarcity and degradation undermine agricultural productivity as well as resilience, with the most negative impacts on the poorest and most vulnerable smallholder farmers, who are often women.

This 2017 report demonstrates the multi-dimensional nature of WLE's work, including WLE's efforts to work on some of the more demanding, and more recently emergent areas, of cross-sectoral and cross-scale risk, such as how tackling water scarcity requires not only field level interventions, but also effective management of watersheds, how urbanization threatens food production in peri-urban areas, or how agricultural technology is not responding effectively to the feminization of agriculture. WLE has investigated (See: public Annual Report, 2017) how these risks can be turned around to find new and alternative ways of managing natural resources, whether this is through circular economy or nexus solutions or how effective solutions can be brought to scale through a more conducive and equitable enabling environment.

Through its five inter-connected flagship programs[1], WLE has continued in 2017 to contribute mainly to the CGIAR's System Level Outcome 3: 'Improving Natural Resources' and System Level Outcome 1 on Reduced Poverty. Key results include:

- Connecting cross-cutting solutions: Resulting from work across two flagship programs, WLE research contributed to new policies in Ethiopia on soil strategies, water technology, and significant advances on restoring degraded landscapes. This integrated approach has exciting potential for WLE's approach in other partner countries (see Outcome Case Study 1).
- Making agricultural water more widely available to smallholders remained a key focus for Flagship 2: Land and Water Solutions working in conjunction with Flagship 4. In 2017, WLE identified some of the specific and unique constraints women face, and have published tools and approaches that help developers of small scale irrigation schemes ensure that women benefit equally from such schemes.
- Building a growing suite of tools and policy interventions, which reduce the risks, to famers and agricultural systems, associated with natural phenomena such as droughts and floods or competing uses of natural resources, has been the focus of Flagship 4 (Variability, Competing Uses and Risks). These include nexus modelling with public sector agencies and roll out of index based insurance schemes.
- Developing the technologies, business models and policy tools in Flagship 3: Rural – Urban Linkages is putting circular economy approaches into practice, with three countries experimenting with and adopting new methods for managing solid and liquid waste, and turning it into commercially viable products, fertilizer, fuel and recycled wastewater for irrigation.

[1] Flagship 1: Restoring Degraded Lands; Flagship 2: Land and Water Solutions; Flagship 3: Rural Urban Linkages; Flagship 4: Variability, Risks and Competing Uses; Flagship 5: Enhancing Sustainability Across Agricultural Systems.

1. Key Results

1.1 CRP Progress Towards Intermediate Outcomes and SLOs

For 2017, WLE has chosen to highlight three outcome studies that demonstrate cross-sectoral ad cross-scale approaches to tackling natural resource productivity and resilience challenges in sustainable agriculture. These include progress on sustainable land and water management in Ethiopia, low cost soil analysis technology in Africa, and instituting resource reuse and recycling into Sri Lankan sanitation policy.

All three cases contribute directly to sub-IDO 3.1: *Land, water and forest degradation (Including deforestation) minimized and reversed*. Together, these cases have the potential to make a significant contribution to achieving the 2022 target of 55 million ha of degraded land restored (and 190 million ha by 2030). Further information is found in Table A-2.

Ethiopia adopts best practice to improve returns on massive investments in soil and water management

WLE research, capacity strengthening and policy engagement has supported Ethiopia's delivery of more sustainable soil and water management. In 2017, the government approved a tax exemption policy to enhance adoption of agricultural water technologies such as solar irrigation and adopted a new national *Soils Strategy*.

Across Ethiopia, the rugged and degraded landscapes, the struggle for sufficient irrigation, and the enormity of environmental deterioration are clearly visible. The country has over 70 million hectares of arable land, and only 12 million hectares are under cultivation. WLE estimates the cost of soil degradation to Ethiopia at $4.3 billion annually. CIAT/WLE research has demonstrated that soil and water management measures, when implemented effectively, can reduce soil erosion by up to 75% and enhance base flow of water by up to 40% with associated positive effects on food security.

WLE is beginning to integrate cross-sectoral and cross-scale initiatives in Ethiopia to create greater synergies for a more sustainable agricultural future. The Ethiopian Prime Minister approved a policy to make all water technologies tax exempt, with the government crediting WLE supported work on irrigation technology and a supply chain analysis influencing this change in policy. IWMI/WLE has been further requested to assess the impacts of this policy change on smallholder farmers.

On soils, WLE researchers helped the Ethiopian Ministry of Agriculture and Rural Development develop a revised 'Ethiopian Soil Strategy' to target soil fertility management interventions. WLE researchers won the Bologna Sustainability and Food International Award for developing approaches to screen and scale-up locally adapted, drought resistant farmers' varieties of durum wheat. And WLE's work with partners on integrated landscape management through the Africa RISING program demonstrated that using its tools and procedures to target interventions can cut soil erosion by up to 75% and improve food security. WLE and its partners developed a framework to guide landscape-level interventions. The procedures have been co-implemented in eight highland watersheds covering 1,500 ha. Ethiopian agencies at federal, state and local levels implementing the Sustainable Land Management Program (SLMP) are now adopting these innovations, aimed at restoring 15 million hectares by 2025.

Together, these achievements demonstrate the benefits of implementing well-targeted and well-managed soil and water management interventions at a landscape scales, while supporting policy-makers to use WLE evidence to provide incentives for new solutions. And with other ongoing WLE initiatives on irrigation business models and soil analysis, Ethiopia will be well placed to ensure that benefits from its investments are maximized. This same integration process has great potential in other partner countries with which WLE is working.

Evidence-based soils management for raising crop production in Africa

The development of rapid and low cost soil and plant analysis techniques, using spectral diagnostic techniques, has enabled 14 countries to make more effective decisions on soil management and soil enhancement in several localities.

Poor soil health is recognized as a major cause of decline in agricultural productivity in sub-Saharan Africa. One of the biggest decision risks to farmers and governments is which nutrient inputs to supply or apply where. Equally, over application can lead to environmental pollution of downstream water bodies. However, making soil nutrient management decisions has not been easy. This is because specific nutrient constraints have been poorly quantified (Shepherd et al. 2015), resulting in a lack of evidence to focus action. Developing low cost tools for measurement of soil nutrient – crop responses under different management interventions, has potential for improving and better targeting remedial measures across larger areas.

To help guide these decisions, ICRAF's Soil-Plant Spectral Diagnostics Laboratory and its partners have developed soil-plant spectral diagnostics tools for rapid and low-cost analysis of soil properties and plant nutrients using only light (infrared, x- rays) (Nocita et al. 2015; Shepherd et al. 2015; Towett et al. 2016). Due to its rapidity and low cost, this technology now allows soil and plant analyses to be done at many georeferenced sites in a country. This high density of data permit digital mapping of soil properties (Hengl et al. 2017) and measurement of plant nutrient constraints in large numbers of agronomic trials.

Through the Africa Soil Information Service (AfSIS) and other projects, such as FoodAfrica, the Laboratory has subsequently helped 14 government institutions, three private sector labs, and advanced research centers, such as Rothamsted Research, adopt the technology and provided training in its use. At national level, AfSIS has helped develop state-of-the-art soil information systems based on spectral technology in Ethiopia (EthioSIS), Ghana (GhaSIS), Nigeria (NiSIS), and Tanzania (TanSIS – Ministry of Agriculture). The Ethiopian Government has generated digital soil maps that are being used to inform fertilizer blending decisions and fertilizer and liming requirements. EthioSIS and TanSIS are each running five infrared spectrometers located in different parts of the country. AfSIS and TanSIS have generated maps of areas requiring liming in Tanzania. These are being used for planning investments by the Ministry of Agriculture and the Bill & Melinda Gates Foundation (BMGF).

Sri Lankan sanitation policy adopts recycling of septage for reuse as fertilizer

WLE research fed the development of Sri Lankan government's sanitation policy, including septage management in the policy, and incorporating options for recycling and reuse of septage into safe organic fertilizer.

The shift to safe recycling of human waste can reduce land and water pollution and associated health hazards, as this waste is often dumped untreated into rivers, wetlands or the sea; avoid costs of septage management, as well as contribute to improved nutrient use efficiency through recycling into organic fertilizer.

IWMI has been working on low-cost options for septage treatment and resource recovery [Nikiema et al. 2014; Cofie et al. 2016], and on identifying business models that can turn waste into organic fertilizer [Rao et al. 2016; Otoo et al., eds. 2018]. These 'circular economy' methods tested and adopted in Ghana (Press Release), are now being taken and applied in other countries with IWMI support (including states in India). IWMI has played a highly influential role in its engagement with the Sri Lankan Ministry of City Planning and Water Supply. This resulted in the 2017 Sri Lankan Sanitation Policy mainstreaming septage management and supporting its safe resource recovery and reuse, addressing nutrient recycling in soils and peri-urban agriculture benefits from fertilizer. With 96% of Sri Lankan households using septic tanks for sanitation waste, this new policy, when rolled

out, will reduce associated hazards and costs, as well as open up new business opportunities for production of recycled products organic fertilizer.

The Cabinet formally approved the final policy in late 2017. The Government formally acknowledged IWMI's support. IWMI has been invited to support the policy implementation process.

1.2 Progress by CRP Flagships

Flagship level results frameworks are reviewed annually to ensure the outputs and milestones continue to reflect the expected impact pathway. Adjustments were made to FP 3 and FP 5 in 2017.

Flagship 1 (Restoring Degraded Landscapes, RDL)

Lead Centres: *CIAT, ICRAF*

Contributes to Sub-IDOs: *Increased resilience of agro-ecosystems and communities, especially those including smallholders. Reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use. Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research.*

Restoring Degraded Landscapes (RDL) finds solutions for restoring agricultural soils and land that have been mismanaged or overexploited. RDL uses research outputs to influence policy and investment for more effective land conservation and restoration. In 2017, RDL supported landscape restoration pilots in Kenya, Ghana, Ethiopia, Colombia, Peru and Uzbekistan, and worked to engage with stakeholder platforms on conservation and restoration planning in Ghana, Tanzania and Nepal. The work supports global efforts, including the Bonn Challenge, a global commitment to restore 150 million hectares of land around the world by 2020. Key areas of progress included:

Tools and information for more effective targeting and monitoring of land restoration responses

- **Soil spectral technology supports institutions in soil fertility assessments:** Through the Africa Soil Information Service (AfSIS) and other projects, ICRAF's Soil-Plant Spectral Diagnostics Laboratory and partners helped 14 government institutions, three private sector labs, and advanced research centers, adopt the technology which is being used to inform soil management and fertilizer related decisions. RDL also improved the capacity of national scientists in soil-plant spectral methods (Ethiopia, Ghana, Kenya, Malawi, Nigeria, Tanzania). (see Outcome Case Study 2 and Capacity Development 1.3.4.)
- **Nutrient maps and land health data to help optimize agronomic interventions**: RDL and partners generated soil micro nutrient maps of sub-Saharan Africa at 250 m spatial resolution using AfSIS data (link), baseline datasets on land health in Cameroon (link), Chad (link), and Ethiopia (link), soil-plant analysis data on multi-location maize trials in Kenya and a report on piloting soil fertility evaluation in Uganda and Ethiopia (link). Soil maps, land degradation assessments, and fertilizer response data were developed for Kenya, Ethiopia and Burkina Faso.
- **Fertilizer recommendations:** Based on extensive evidence generated from about 600+ on-farm experiments by ICRISAT and partners in Ethiopia, a decision tool has been developed with the approach adopted by the Ethiopian Institute of Agricultural Research. A task force was created to institutionalize it at regional and local levels. It was widely validated in three major farming systems. In addition, following this work, by serving on a core advisory team, WLE helped the Ethiopian Ministry of Agriculture and Rural Development develop a revised "Ethiopian Soil Strategy" signed by the Minister in November 2017. (see Outcome Case Study 1)
- **Learning platforms:** An innovative partnership platform called a "learning alliance" was launched in Tanzania in collaboration with CCAFS. Through a facilitated process, members of the alliance proposed a prioritization plan of local level soil and water management interventions.

- **Tools for planning and monitoring soil and land restoration responses:** a new analytical approach for planning and performance management of land restoration initiatives was tested together with IUCN and Technoserve. The framework and example applications in natural resources management and policy analysis quantifies the costs, benefits and risks associated with proposed interventions and identifies key variables for monitoring the performance of restoration actions. It aims to help countries better understand their progress towards land restoration commitments.

Piloting and testing of soil and land management solutions

- **Improved soil and water management by Ethiopian government agencies:** in collaboration with other CGIAR centers, under the USAID-funded Africa RISING Initiative in Ethiopia, various landscape level soil and water management technologies were implemented (link1, link2) and lessons learned summarized in a book chapter (link). WLE trained national scientists and stakeholders on soil and water management and landscape restoration (example) and Ethiopian agencies implementing the Sustainable Land Management Program (SLMP) are now adopting these innovations, aimed at restoring 15 million hectares by 2025 (see Outcome Case Study 1).
- **Making the case for soil carbon as a climate solution**: Building on RDL soil carbon mapping work, WLE research found that up to seven billion tonnes of carbon dioxide can be sequestered each year through better soil management on farm land. The findings were published in the high-impact Nature Scientific Reports (Altmetric score 316). Lessons on the global importance of soil health, micronutrients and carbon sequestration were published widely including in Scientific American, and presented at events such as the FAO *Global Symposium on Soil Organic Carbon*. The UNFCCC Conference of the Parties' Korinivia decision formally recognized the critical importance of soil carbon for climate change mitigation. WLE helped build the case for a decision through CIAT's publications, events and data, with advice provided to GIZ and BMZ. Other progress on demonstrating the value of soil carbon in climate change mitigation included:
    - Scientists developed a soil organic carbon/fertility online tool/guide and promoted its adoption by county governments in Western Kenya.
    - Intensive soil sampling and analysis, among others by infrared spectroscopy, was done in Western Kenya and Ethiopia, including sampling of chronosequence[2] of sites under increasing years of land use, for determining underlying mechanisms that drive soil carbon loss and potential for (re)sequestration in a predictive fashion.
    - Integration of these methods into monitoring activities on Land Degradation Neutrality (LDN) progress at the UNCCD COP 13 (Blog 1; Blog 2).
    - Baseline mapping results published in a peer-reviewed journal article, to help build more accurate maps and tradeoff scenarios.
    - Expert trainings on advanced assessment methods and provided support to the UNCCD Land Degradation Neutrality pilot country, Namibia.
    - A project was initiated to develop a Soil Organic Carbon Measurement and Indexing System using infrared spectral technology, through a PhD scholarship award in Soil Technology Innovation under the new Agricultural Research and Innovation Accelerator (AgRIA), sponsored by Rothamsted Research and Cranfield University.
    - Findings published that challenge the opinion that controlled grazing enhances soil carbon sequestration in southern Ethiopian rangelands.

[2] A sequence of related soils that differ in their degree of profile development because of differences in their age. Chronosequences can be found in evolving landscapes such as those produced by deglaciation, volcanic activity, wind deposits, or sedimentation (https://www.encyclopedia.com/science/dictionaries-thesauruses-pictures-and-press-releases/chronosequence-1).

- **Targeting crops to local conditions for better land restoration.** Bioversity/WLE developed approaches that make the most of agricultural biodiversity for land restoration. For example:
    - Researchers in Uzbekistan have identified salt and heat tolerant fruit tree varieties (apple, apricot and grape) that can be used to stabilize degraded pastures, establishing silvopastoral systems to reduce soil erosion. These approaches are being promoted by the Uzbek government (link).
    - Researchers in Nepal have identified cold-tolerant varieties of crops (rice, barley, buckwheat, millet), which are being used to improve agricultural ecosystems (link, link).
    - In China, grass-legume mixes are being evaluated to restore productivity of degraded grasslands (link).
    - In Ethiopia and Nepal, participatory methods have been developed for farming communities to screen crop varieties for local conditions (link) through research receiving the 2017 Bologna Sustainability and Food International Award.
    - In Uganda, crop mixtures have been tested to improve the resilience of beans to pests and diseases (link). Community seed banks have been established to manage and distribute planting material. These approaches are complementary to approaches developed through the Forest, Trees and Agroforestry CRP (link).
- **Conserving silovopastoral ecosystems in Colombia:** the Sustainable Amazonian Landscapes (SAL) project produced a manual on the characteristics and recommendations for grass, legume, and shrub species that can be employed in silvopastoral systems. Twenty-four farmers covering 126 ha signed an agreement to conserve and restore the natural landscapes on their farms and improve livestock sustainability. The project has also supported 18 local students and sponsored farmer-to-farmer exchanges between Colombian and Peruvian farmers.

Gender and land restoration

- **Data on impact of soil and water conservation on women and youth:** A survey was carried out in the Upper Tana Basin to analyze the impacts of land restoration and conservation on women, resulting in recommendations for more socially equitable land restoration investment for the Upper Tana Nairobi Water Fund. The implications of out-migration and changing youth aspirations on sites undergoing land restoration in Ethiopia and Kenya were also assessed.

Flagship 2 (Land and Water Solutions, LWS)

Lead Centres: *IWMI, ICRISAT*

Contributes to Sub-IDOs: *Reduced smallholders production risk. Agricultural systems diversified and intensified in ways that protect land and water*

LWS develops and applies solutions for managing land and water in rainfed and irrigated agricultural systems that are sustainable at field and landscape scale. Building on the research, methodologies and business models completed in Phase 1, LWS partners have focused activities in India and Ethiopia. Key areas of progress include:

Decision support tools for agricultural land and water management

- **New methodologies for assessment of irrigated area potential:** have been developed and piloted in sub-Saharan Africa to support better allocation of water between sectors and users. When shared with the Ethiopian Ministry of Agriculture, the Minister of Agriculture and Natural Resources, H.E. Dr. Eyasu Abraha, stated, *"above all it is a call for policy makers in the sector to adapt the approach."* The Ethiopian Ministry of Water has similarly expressed interest to apply and scale up the methodology for use in Ethiopia once further assessment is completed. An example has also been developed for South Africa's Limpopo province, suggesting a significant underutilization of irrigation potential (Cai et al. 2017). Similar decision support has

been provided through maps for Euphrates-Tigris river, to identify rainfed and irrigated areas and associated water productivity impacts.

- **Expanding irrigation potential sustainably using surface and shallow groundwater:** building on the mapping tool above, under the USAID-ILSSI project, WLE assessed potential for small-scale irrigation in Ethiopia (Worqlul et al. 2017). The assessment involved using a combined biophysical and socio-economic assessment tool with a focus on ensuring that irrigation does not adversely affect other water uses or environmental flows. It showed the potential area of groundwater irrigation to be double the current estimated potential area of 3.3 million ha. A similar study for Nigeria (Xie et al. 2017), provides a similarly large scope for further expansion, up to an area of 1 million ha for sustainable smallholder dry season irrigation, given the current investment landscape.
- **Innovations to improve performance of irrigation schemes:** Using participatory approaches, researchers identified how incomes, water and nutrient efficiencies can be improved through use of benchmarking tools, private-public-partnership (PPP) arrangements, improved market connections and capacity development. Four lessons emerged from this research: 1) because small-scale irrigation schemes are complex systems, multiple, concurrent interventions are required to transform them to more profitable and sustainable states; 2) it is as important to invest in people and their capacity, as in hardware to achieve success; 3) governments need to clarify their objectives and empower farmers and system operators; and 4) effective markets provide both the incentive and the means to invest in irrigation schemes. Evidence was delivered through high quality journal publications, and shared through various national, international and global events. Work to develop and update online systems (Systematic Assessment Management System, SAMS) for irrigation benchmarking has continued through 2017 and will be presented to key fora in 2018. IWMI/WLE research highlights that there is no silver bullet, as irrigation schemes are complex systems where multi-pronged interventions are needed. Formal change management processes are required to aid adoption of innovations. Phase 2 will test this proposition.
- **Learning and knowledge transfer tools:** Innovation Platforms – forums where a range of stakeholders convene to plan, test and evaluate new technical, institutional and policy interventions – have proven highly effective to change irrigation scheme benefits and efficiencies, both for farmers and for water productivity gains, (Van Rooyen et al. 2017 and Op-Ed). These have been piloted in Zimbabwe and Tanzania. They add to WLE's repertoire of participatory tools such as the participatory game playing for ground water management, the game on managing check dams for practitioners, and a similar experience in coastal Bangladesh aimed at helping people think out of the box around water sharing and efficiency. A special issue of the International Journal of Water Resources Development reports findings from six small scale irrigation schemes management in Mozambique, Tanzania and Zimbabwe (WLE with ACIAR). ICRISAT along with Australian National University (ANU), FANRPAN and other partners collaborated to test a specific combination of technical and institutional change methods to increase irrigation water productivity and profitability. The two-pronged approach consisted of introducing two smart water management tools and, supporting Agricultural Innovation Platforms to bring key stakeholders together to co-develop solutions to challenges including scheme management, input supply, production and marketing. The frequency of irrigation, over-use of fertilizers and labor costs were significantly reduced, while crop yields, irrigated area and profitability were significantly increased. A follow-on project has commenced to learn how to scale the lessons up and out.
- **Strengthening capacity to implement ALWM solutions:** Capacity development was also an important intervention of the ALWM work, with tertiary and vocational training implemented at institutional and individual levels and multiple workshops to build capacity in National Agricultural Research Extension Systems (NARES) partners. WLE supported curriculum

development at Arba Minch, Addis Ababa and Jimma universities in Ethiopia, as well as capacity development on small-scale irrigation and support for MSc and PhD scholarships. The use of Innovation platforms in Mozambique in a bilaterally funded project built capacity to manage the impacts of drought in the actors of a goat value chain. In India, NARES partners are requesting access to modelling tools such as the Integrated Assessment Tool which is a household bioeconomic model applied to understand the impacts of AWLM on farm level cash flow. ICRISAT organized a three-day workshop on the tool with the participation of over 30 scientists from six Indian Council of Agricultural Research (ICAR) institutes.

Supporting piloting and scaling of agricultural land and water management

- **Promoting productivity gains through better ALWM**: through working on rainfed agricultural technologies promoted such as: conservation agriculture, mechanized raised beds, and biophysical soil and water conservation/ rainwater harvesting measures. Areas of focus included: the Middle East and North Africa (MENA) region (Egypt, Jordan,) Asia (India) and West Africa (Mali, Ghana, Niger). Products included scientific publications (Rejani et al. 2017; Tamene et al. 2017; Zegeye et al. 2017;), policy briefs and various stakeholder engagements. Some work was also done on exclosures in the Ethiopian highlands particularly in the role they play in watershed management (Mekuria et al. 2017, and presented at the Global Landscape Forum (Bonn 2017).

- **Scaling up solar-powered irrigation in India:** The WLE- and CCAFS-supported IWMI-TATA Program recommendations reported in previous WLE Annual Reports have been used during 2017 by the Government of India to design new investments in irrigation development. As part of the 2018 Budget Presentation to Parliament, the Indian Finance Minister pledged:

    - US$7B to install grid-connected solar pumps with surplus power buy-back arrangements (building on the Dhundi Solar Project model, see ITP Research Highlight #10); and
    - US$400M for groundwater irrigation in irrigation-deprived districts (building on ITP's review and recommendations for the Prime Minister's Krishi Sinchai Yojana (see ITP Research Highlight #1)

  A new publication provides an account of the Indian solar irrigation discourse and the possibilities for the future.

- **Low cost and environmentally sustainable business models for using solar PV technologies** for surface and shallow groundwater extraction for irrigation. The results of this research were recently published (Otoo et al. 2018), summarized in a brief, and widely shared in 2017. The challenge is to tailor this technology to specific circumstances in a way that will expand irrigation access to the largest number of poor people while keeping costs affordable and minimizing its environmental footprint, especially over-pumping of aquifers. In Ethiopia, IWMI/WLE and its partners, through the Africa RISING project, are studying how to accelerate wider use of this technology in a profitable *and* sustainable manner. Based on these piloting efforts, the Ethiopian Agricultural Transformation Agency (ATA) invited IWMI/WLE to undertake the baseline survey for Monitoring, Evaluation, Impact Assessment and Learning (MEL) of its solar powered irrigation investments.

- **Supporting and advising IFIs and governments:** Advising the Ethiopian Ministry of Water, Irrigation and Electricity and the Agricultural Transformation Agency (ATA) on smallholder irrigation development, LWS also responded to requests from international finance institutions (IFAD, World Bank) and development agencies (Sida, USAID) for guidance on how to improve productivity through ALWM. An example is the invited joint product with the World Bank on addressing the water productivity discourse (Giordano et al 2017). In 2017, the Ethiopian Prime Minister approved a policy to make all water technologies tax exempt, with public acknowledgement of IWMI's influence. WLE researchers were also approached by Global Good to present on WLE Phase I findings related to smallholder irrigation opportunities in sub-Sahara

Africa to the Global Good Fund). LWS researchers have more recently been approached by Global Good to co-develop and co-pilot technologies and decision tools to support smallholder livelihoods and productivity (see Outcome Case Study 1).

Gender and agricultural water and land management

- A special effort on gender has resulted in significant gender-related outputs: studies on gender in small-scale individual irrigation, and medium–large scale schemes, were published providing ground breaking evidence on gender and opportunities for transformative change. These results are discussed in detail in Section 1.3, below.

Flagship 3 (Rural-Urban Linkages, RUL)

Lead Centres: *IWMI, RUAF Foundation*

Contributes to Sub-IDOs: *Conducive agricultural policy environment. Increased capacity for innovation in partner development organizations and in poor and vulnerable communities.*

RUL aims to maximize urban food security, identify new business opportunities for young women and men from resource reuse and recovery (RRR), and minimize the footprint of urbanization.

- **Resource recovery and reuse business models:** RUL's research focused on financial models, public-private partnership models, and the investment climate for RRR in East Africa and South Asia. The RRR business model catalogue brings together years of research and is a landmark publication presenting 47 analyzed RRR case studies (analyzed 2015-2017) of which 24 business models were extracted to serve business schools as teaching material. All models incorporate gender as a cross cutting issue. In 2017, IWMI/WLE started transforming its RRR knowledge base into multiple curricula, including modules for existing Massive, Open, Online Courses (MOOCs) to support students, start-ups and practitioners in the global South. This year also saw the official inauguration of the "Fortifer" compost plant in Ghana, a PPP facilitated by IWMI, and reported in the previous WLE Annual Report, as well as the signing of new MoUs with two municipalities and two private sector partners in Sri Lanka to produce and test waste-based fertilizers. The project was part of a recent evaluation commissioned by the BMGF.
- **Wastewater reuse for irrigation:** IWMI/WLE contributed to the first global assessment of the area under direct and diluted wastewater irrigation, which was reported by BBC, Al Jazeera, Reuters and others. Aligned with the UN World Water Development Report on "Wastewater: the Untapped Resource" to which IWMI contributed significantly, a year-long wastewater reuse communication campaign took place which included blog contributions, and some publications, like "Wastewater reuse in numbers", and with FAO, "Wastewater Reuse in Latin America and the Caribbean." The highlight of the campaign was the 2017 World Water Week in Stockholm, where IWMI functioned as key collaborating partner, member of the Scientific Program Committee, and co-convener/advisor of four out of nine scientific whole-day seminars.
- **Training of governments, farmers, refugees and other stakeholders on improving RRR practices:** Among the project-based outreach activities, WLE/IWMI in collaboration with UNOPS (United Nationals Office for Project Services) trained 231 participants from local authorities in Eastern and Northern Sri Lanka, on wastewater treatment, solid waste management and best technical and marketing practices for RRR. ICRAF/WLE also supported training in Kenya for women from refugee and host communities on how to produce cooking energy in the form of fuel briquettes through processing organic residues. This economically empowers local women, reduces their burden to find fuel, and the related pressure on forests and soils. Other WLE/IWMI also carried out training in Uttar Pradesh, Bihar and Jharkhand state, in India, where 150 master trainers were trained to develop action plans for improved village level strategies on Solid, Liquid and Fecal Sludge Management; and in Ghana, where about 100 farmers were trained on the application and use of Fortifer compost in three irrigation schemes.

- **Contribution to development of Sri Lankan sanitation policy:** the cabinet approval of the National Sanitation Policy of Sri Lanka incorporating options for recycling and reuse of septage into safe organic fertilizer. The Sri Lankan government formally acknowledged IWMI's contribution. IWMI has also been asked to support the policy implementation process (see Outcome Case Study 3).
- **Set up of demonstration plant for safe communal wastewater collection and treatment:** in Delhi, to be replicated in other low-income communities in the city. The plant, if replicated, could benefit an estimated 9 million slum dwellers in the Indian capital.
- **Support for local urban initiatives and global dissemination:** RUL seeks to support initiatives in eight cities in five countries by 2022 and works at city, region and national levels. For example, in 2017, RUAF supported the integration of WLE into the Urban Food Forum and the new CITYFOOD network (ICLEI-RUAF-FAO). This involved (i) participation in the ICLEI conference on Resilient Cities in Bonn (4-6 May 2017); (ii) the development of city-region food systems (CRFS) indicators taking into account different sustainability dimensions including on gender and youth employment; and (iii) partnering with WLE for the first CITYFOOD webinars on the "City Regional Food System" (CRFS) concept.
- **Supporting cities to analyze their food systems:** RUAF/WLE has been supporting the following cities' local authorities in analyzing their city-region food systems for strengthening local capacity and policy development: Colombo (Sri Lanka), Nairobi (Kenya), Cali (Colombia), Tamale (Ghana) and Ouagadougou (Burkina Faso). The results from Tamale and Ouagadougou were previously reported. Led directly by RUAF, CRFS assessments were also carried out in Quito (Ecuador) where WLE supports in particular the vulnerability assessment of the CRFS, and in Medellin (Colombia) as well as Toronto, Canada. The WLE work is helping cities develop a framework, policies and action plans to build sustainable and resilient city region food systems. In addition, 15 cities took part in a webinar on the concept of CRFS assessment and planning. The Flagship also supported stakeholder meetings in the cities of Cali and Palmira (Colombia), Quito, and Nairobi in the development and adoption of a monitoring system for policy implementation on urban and peri-urban agriculture/city region food systems (UPA/CRFS) innovations (ongoing process; Nairobi indicator report forthcoming in 2018). Data generated from the city studies is contained in a detailed report on private sector involvement in CRFS, a related policy brief on the role of private sector, a Colombo report and two Colombo specific policy briefs on food waste and food security by the FAO-RUAF CRFS program in Colombo, Sri Lanka. RUAF-WLE also co-published Urban Agriculture Magazine Vol 32 on the Food-Waste-Energy Nexus.
- **Understanding gender dynamics of urban vegetable production:** A new research paper from West Africa reinforces the notion that gendered relations are just as important as gender roles by documenting the role of urban and peri-urban vegetable production for men and women (submitted to Agriculture and Human Values). In 2017 RUL also produced an analysis of the spatial dynamics of urban farming under the pressure of urban growth ("urban shifting cultivation" – to be published).
- **Dissemination and promotion of research on nutrient, water and energy recovery:** Other evidence of delivery of the 2017 milestones includes the aforementioned Urban Agriculture Magazine Vol 32 on the Food-Waste-Energy Nexus, five manuscripts under review for the RRR report series, further input into the global AQUASTAT database, an internal greywater guidance document for World Bank staff, the pre-launch of the FAO/WLE book titled "More people, more food, worse water?: A global review of water pollution from agriculture", and about ten journal papers and book chapters e.g. in Water, Science and Technology, Environ. Res. Letters, Water Alternatives, Ambio or the Routledge Handbook of Landscapes & Food. These will be used to show practitioners and decision-makers better evidence-based options for nutrient, water and energy management.

Flagship 4 (Variability, Risks and Competing Uses, VCR)

Lead Centres: *IWMI, IFPRI*

Contributes to Sub-IDOs: *Enhanced capacity to deal with climatic risks and extremes. More productive and equitable management of natural resources. "reduced production risks" and "increased resilience of agro-ecosystems and communities, especially those including smallholders".*

VCR aims to reduce risks and losses that farming communities suffer from water-related disasters by managing water variability and competing uses across the water-energy-food nexus including on groundwater management, food and drought risk management and natural infrastructure.

- **Developing risk management solutions:** VCR continued with research on innovative risk management solutions for floods and droughts to support national strategies for disaster risk management in South Asia and Africa. Amarnath et al. (2017) described a combined index-based approach on hazard, exposure and adaptive capacity to identify areas susceptible to extreme risk. Yoshimoto et al. (2017) tested the performance of three Satellite Rainfall Estimate (SRE) products applied to flood inundation modelling in a Sri Lankan river basin. The procedures tested can help authorities make better flood warning decisions in areas where data are limited. Applying these approaches in India, WLE and its partners (CCAFS, the Indian Centre for Agricultural Research (ICAR) and in conjunction with the Agency Insurance Company India (AICI) and SwissRe insurance company), launched an Index Based Flood Insurance (IBFI) pilot scheme covering 200 farmers across six villages in the Muzaffarpur district of Bihar, India. Forty-three eligible farmers received payments through direct bank transfer. The advantage of using remote sensing data to identify flood-affected areas include lower cost, more rapid and objective assessment and thus faster payouts. This is especially important for the poorest smallholders. The results, were widely published by the Economic Times, Business Standard, and other outlets. Expressions of interest for scaling out were received from the World Bank. Moreover, a case study was published in the 2017 Asia-Pacific Sustainable Development Report.

- **Supporting Bihar government in responding to floods:** Supported by WLE and CCAFS, IWMI and its partners (ICAR and others) provided rapid emergency response flood mapping to the Bihar State Disaster Management Authority during monsoon floods (August 2017). These facilitated more timely response to assist local communities faced with serious flooding. WLE and its partners have also completed cost-benefit analyses and development of business models for IBFI (a report will be published in 2018).

- **Drought bulletins provided to Indian state governments:** working with the South Asia Drought Monitoring System (SADMS), periodic drought bulletins were produced in collaboration with ICAR. These were utilized by authorities to advise farmers across nine states in India (February 2017). Drought classes were mapped and drought-affected area computed for each district in each state. In the worst affected states (i.e. Andhra Pradesh, Tamil Nadu and Karnataka), SADMS indicated drought across a total of 57,470 km^2. Periodic drought bulletins were prepared and shared with drought and water resources authorities. The bulletins were also shared with the Secretary, Ministry of Water Resources and with the Cabinet Secretary (Government of India). Briefings on the state of drought in different districts were provided to Members of Parliament and State-level Principal Secretaries. The information provided was used to better target and inform drought relief efforts.

- **Developing drought monitoring tools across Asia**: IWMI was nominated as a project manager by the International Disaster Charter to support the Sri Lankan Disaster Management Centre. WLE is developing a new drought index using satellite-based soil moisture data for South Asia. It is also building capacity on drought monitoring across Southeast Asia, in conjunction with UN-SPIDER – the UN agency responsible for facilitating the use of space-based technologies for disaster management and emergency response – and the Thailand Space Agency.

- **Establishment of a drought-monitoring framework for the Southern Africa:** IWMI/WLE supported the regional work (based on SADMS) for FAO (Southern Africa Resilience Hub). In 2015, IWMI had prepared emergency response maps for Nigerian floods and flood recession agriculture. This year, while receiving the 2017 World Food Prize, Akinwumi Adesina, President of the African Development Bank, expressed his appreciation for this assistance.
- **Developing crop health cards for Indian states:** these comprised information on climate, staple crop growth condition and damage for 17 districts in two Indian states (Uttar Pradesh and Haryana). This work was commissioned by the Bajaj Allianz insurance company and contributed to the central government scheme Pradhan Mantri Fasal Bhima Yojana (PMFBY). In addition to satellite-based crop monitoring, electronic data collection was employed using an Open Data Kit to capture information on crop condition, geotag photos, as well as feedback from farmers on the crop phenology and expected yield. All the field survey information was saved in real-time. Overall, WLE's framework promotes utilization of the cloud-based platform and artificial intelligence in crop mapping.
- **Advising governments on how to best combine built and natural water infrastructure:** through WISE-UP to Climate, in a partnership led by IUCN. VCR analyzed trade-offs between built and natural infrastructure. The outputs were used in policy advice in Kenya and Ghana, using an "action learning" process designed to increase interaction between researchers and decision makers to ensuring that evidence and tools developed were more attuned to the realities of decision-making and consensus building. The study was presented by the German Minister of Foreign Affairs as one of three activities highlighting German commitment to Africa, at a meeting on the sidelines of the UN General Assembly in September 2017. A climate change assessment conducted for the Tana River basin underpinned the importance of the link between ecosystem services supporting the performance of built infrastructure and possible changes arising from climate change.
- **Shared solutions on sustainable groundwater management:** The Groundwater Solutions Initiative for Policy and Practice (GRIPP), a global partnership promoting sustainable utilization of groundwater, brought the partnership to 29 members and increased visibility through online posts and presentations at 15 international meetings. Aarnoundse and Bluemling (2017) assessed the use of two approaches to managing groundwater use in China and found regulation through smart cards on pumps based on quotas was more effective and equitable than a tiered pricing approach. A brief on Building Resilience through Sustainable Groundwater Use was published to support decision-makers.
- **Scaling out Underground Taming of Floods for Irrigation" (UTFI):** Research into managed aquifer recharge as a flood mitigation measure that also enhances water storage for irrigation continued with more trials in India that confirmed that additional volumes of water stored in the aquifer do bring benefits for farming households. Trials initiated in Vietnam in 2017 in conjunction with Nestle and the Swiss Agency for Development and Cooperation (SDC) are also bringing tangible benefits to coffee farmers in Dak Lak province. A Special Session on this topic was held at the World's Large Rivers Conference in Delhi, April 2017.
- **Assessments of groundwater agriculture in the MENA:** Groundwater Governance in the Arab World was successfully completed, creating case studies, dialogues and high-level events in Tunisia, Jordan and Lebanon, and a global synthesis also developed. The research provided many insights into the gravity and complexity of the groundwater situation in the region. Its findings were widely reported at a number of international fora and garnered significant attention from the media, including an article in the Guardian and the Arabic press.
- **Supporting governments and institutions in groundwater management:** in Lao PDR, the first national hydro-geological map and dataset were handed over to the Groundwater Division of the Department of Water Resources, for use in national groundwater planning and

management, supported by a policy brief on groundwater for irrigation in Laos. In southern Africa, the SADC GMI (Groundwater Management Institute) has adopted a training manual on Integration of Groundwater Management into Transboundary Basin Organizations in Africa and requested IWMI contributions to the development of its research and communication strategies.

- **Improved monitoring of SDG water progress:** WLE works with several global mechanisms (e.g. Ramsar Convention, IPBES, and with the UN on SDGs). In 2017, VCR contributed to the development and publication of the International Council for Science (ICSU) report on A Guide to SDG Interactions: from Science to Implementation which proposes a simple assessment tool to understand tradeoffs and synergies across the SDGs. The tool was launched at the UN in February and is since being applied by a growing number of researchers and practitioners, including to the Zambezi Basin, the Niger Basin, and has been extended to include linkages with the Paris Climate Agreement on country NDCs.
- **Support for monitoring water-related SDGs:** Guidelines for indicators to monitor SDG 6.6.1 (water-related ecosystems) were developed and published by UNE. Also in conjunction with UNE, training courses were conducted in eight countries (Jamaica, Peru, Zambia, Cambodia, Bangladesh, Nepal, Fiji and Cameroon) on SDG 6.3.2 (ambient water quality) and SDG 6.6.1 (water in ecosystems). Research continued on the development of guidelines for the use of Earth Observation data for SDG 6.6.1 based on global datasets. A special session was organized on behalf of Ramsar at the International Symposium of Remote Sensing of the Environment on "Wetland's Monitoring" (May 2017) and a Ramsar technical report will be published in 2018.
- **Contributions to major international reports:** WLE researchers contributed case studies and wrote sections for the 2018 World Water Development Report on Nature Based Solutions (NBS) including chapters on *Managing NBS for water availability*, *NBS for managing water quality* and *NBS for managing water-related risks, variability and change*. VCR researchers contributed to the IPBES regional assessments on biodiversity and ecosystem services for Africa as well as Asia and Pacific during 2017; both were published in 2018. For the latter, a VCR researcher co-chaired the Asia and Pacific regional assessment.
- **Nexus scenario analysis and decision support:** WLE co-developed scenario analyses for decision makers on integrated water-energy-agriculture development and provided policy advice on trade-offs and synergies across water, land and energy resources, targeted at selected basin, national, regional, AFSs and global levels. Specifically:
    - VCR contributed to a small research activity on assessing water, energy and food linkages in the Eastern Gangetic Plains to support potential upscaling of a conservation agriculture for sustainable intensification program led by CIMMYT in the region.
    - In the Eastern Nile Region, a bilateral WLE project led by IFPRI aims to improve the understanding of linkages, tensions and tradeoffs across the water-energy-food nexus using global, basin (Eastern Nile) and local case studies (Ethiopia), and to develop alternative water, energy, and food management, technology and governance options that sustainably increase resource use efficiency for the rural poor in ways responsive to the needs of women and men. In 2017, the project published a paper on the potential of cooperation in the Eastern Nile through a Water-Energy-Food Nexus perspective as well as a modeling framework linking the economics of water, energy, and food. The study assessed the potential for decentralized energy development and analyzed alternative energy supply and demand strategies with a focus on renewable energy strategies. Based on these contributions, the Nile Basin Initiative (NBI) invited IFPRI/WLE to co-organize the First Nile Basin Economist Conference that was held in May 2017 in Uganda. Moreover, the GIZ Nexus office asked VCR researchers to develop a nexus assessment and implement nexus training in Sudan, drawing on insights and results from the project.

- WLE has also completed a groundbreaking study on irrigation-energy linkages with a focus on the interactions between hydro-electricity and irrigation development. Using machine learning techniques and drawing insights from the International Model for Policy Analysis of Agricultural Commodities and Trade (IMPACT) modeling system, the study found that 54% of global installed hydropower capacity or 507 Gigawatts (GW) directly competes with irrigation, meaning that increased hydro-electricity production might reduce food security. At the same time, 8% of globally installed hydropower capacity strengthens irrigation, particularly in the Yellow and Yangtze River Basins of China, the East and West Coasts of the United States, and most river basins of Southeast Asia, Canada and Russia. No significant relationship was found for the rest of the world, and also not in much of Africa where neither irrigation nor hydro-power have yet been fully developed.
- VCR continued to collaborate with the Food Energy Environment and Water (FE2W) network on further developing and applying an innovative decision support framework that addresses risk and resilience around the food, energy, environment and water nexus. FE2W in partnership with VCR published the Guide to ROAD (Risks and Options Assessment for Decision-Making Process) and successfully applied ROAD in a case study in the Central Highlands of Vietnam.

- **Capacity development and nexus policy dialogue:** Capacity development was a key area of work on the nexus, alongside policy dialogues and knowledge products on nexus and energy modeling (for example, Mondal et al. 2017, McCarl et al. 2017). Collectively, these activities inform policy and investment, including through training on energy systems modeling for Ethiopian government agencies to help meet energy demands while reducing greenhouse gas emissions. VCR also supported multilateral development institutions, such as the ADB, to test a water-energy-agriculture checklist focused on resource conservation in irrigated agricultural projects; supported analysis of the impact of a more carbon neutral future on the Philippine economy; and provided technical inputs into water-energy-food nexus initiatives for the Eastern Nile and Southeast Asian countries.

Flagship 5 (Enhancing Sustainability across Agricultural Systems, ESA):

Lead Centres: *ICRAF, Bioversity, IWMI, IFPRI*

Contributes to Sub-IDOs: Increased capacity for innovation in partner development organizations and in poor and vulnerable communities. Agricultural systems diversified and intensified in ways that protect land and water.

ESA supports development decisions and investments for more sustainable agricultural landscapes by developing user-friendly approaches and tools to assess and manage scale effects of agricultural interventions on selected Sustainable Development Goal (SDG) targets.

- **Revised approach to enhancing sustainable agricultural systems:** The ToC for Flagship Program 5 (FP5) on Enhancing Sustainability across Agricultural Systems (ESA) was revised as part of the resubmitted FP5 Proposal, which was approved for W1/W2 funding by the System Council in November 2017. FP5's ToC now focuses on improving the approaches and tools that enable more effective management of landscape level impacts of agricultural and natural resource management interventions. The revised approach requires much closer co-working with decision-makers, as well as with other CGIAR Research Programs (CRPs). A focus on the landscape scale makes better use of WLE's value added to other CGIAR work on sustainable agricultural intensification that focuses largely at the field level. FP 5 did not receive W1/W2 funding in 2017.

- **Developing approaches for landscape management:** In the absence of W1/W2 funding, activity on the development of new tools and approaches was limited. However, ongoing bilaterally funded research enabled the continued development of some specific approaches for landscape management. For example, in the Volta Basin (Bioversity funded by Economic and Social Research Council (ESRC) and the Netherlands) approaches have been developed to map small reservoirs in Burkina Faso and use ecosystem service models to facilitate their management by local communities. Ongoing research by Bioversity/WLE in Cuba, China, Philippines, Tunisia and other countries) has developed approaches to help communities to manage landscapes for multiple ecosystem services. This includes marketing and labelling opportunities for landscapes with rich agro-biodiversity, and the development of methods that support agro-biodiversity inclusion in local and global land use management decisions (e.g. link). Training modules were developed for farmers on participatory mapping and ecosystem service assessment in the Philippines and Tunisia.
- **Synthesizing results from Phase 1 work and disseminating the results widely:** Achieving sustainable, healthy food systems requires the identification of incentives for sustainable farming. Likewise, it hinges on social and institutional innovations to mitigate trade-offs and achieve synergies and enable equitable access to knowledge and resources. Not least, integrated solutions that work across sectors, disciplines and scales will be essential to realizing such a fundamental shift. WLE has produced a series of seven briefs, titled *Towards sustainable intensification: Insights and solutions*, synthesizing solutions on the following topics: upper watersheds, gender, river deltas, groundwater, soils, dams and smallholders.
- **Initiatives to provide decision makers with options to build resilience and produce datasets and tools for water and land accounting and agro-biodiversity monitoring:** The ESA decision analysis work continued, developing approaches for participatory decision modeling, spatial intervention targeting, and ex-ante impact models for decisions. A decision analysis framework for land restoration planning and performance management was developed for land restoration and piloted (see Flagship 1). In partnership with the University of Bonn, WLE's participatory decision analysis framework was further developed and tested with an ex ante assessment of national agricultural policy on household nutrition in Uganda using Bayesian Networks (link). A decision analysis methods guide was produced based on this example (link). Another example application valued ecosystem services of intervention options in semi-arid rangelands in Namibia through stochastic simulation (link). A probabilistic assessment of investment options in honey value chains in Lamu County, Kenya, was submitted for publication.
- **Improving modeling for agricultural decisions:** WLE worked with Queen Mary University London to include a value of information tool in the Bayesian Network software package AgenaRisk. The software uses the latest developments from the field of Bayesian artificial intelligence and probabilistic reasoning to model complex, risky problems and improve how decisions are made. We also made further improvements to WLE's own MonteCarlo simulation package for decision analysis, written in R software, to provide identification and graphical representation of which variables have high information value where further measurement is justified, and of which variables contribute to positive and negative outcomes. The decision analysis methods were further disseminated through a tool kit Enabling Decision-Making for Agricultural Interventions. Other ESA projects developed modeling frameworks for analyzing ecosystem services in large river basins, with a focus on the key WLE focal regions and made both the model code and scenarios for online use available.
- **Improving value for money of investments:** A bilateral project under FP5, the Bridge Collaborative, produced a series of outputs aimed to enhance the value for money of investments in development through incorporating environment and health perspectives. The initiative launched two products in October of 2017: A Call to Action; and Principles and Guidelines for Cross-sectoral Collaboration.

Gender and Enhancing Sustainability in Agriculture

- **Cross cutting activities:** The impact pathways modelling work in Kenya had an explicit gender component, distinguishing between the nutritional requirements of men and women, including pregnant and lactating women. Greater Mekong research addressed a number of gender related questions, including how benefits and costs from water and land development are distributed; the role of women in the management of river health and the relevance of gender for water and associated land governance. The Flagship also supported research on identifying gender sensitive market opportunities; approaches to enable poor rural women and men to benefit from agricultural heritage systems; facilitated the creation of women's groups for income generation activities; and worked on inclusion of women in decision-making processes. Interviews with 171 farms in two *Man and the Biosphere Reserves* in Cuba highlighted major issues which limit gender equity in Cuban agriculture. This generated information that is contributing to the implementation of the Cuban Ministry of Agriculture's gender strategy.

1.3 Cross-Cutting Dimensions (at CRP level)

1.3.1 Gender

In 2017, as part of its series on insights and solutions for sustainable agricultural intensification, WLE produced a brief on gender-equitable pathways to intensifying agriculture sustainably. The brief presents the following recommendations:

- Invest in studying gender contexts, barriers and opportunities, when designing and implementing sustainable agricultural intensification, to secure more gender equitable solutions.
- Use systematic participatory methodologies (e.g., WLE's Gender in Irrigation Learning and Improvement Tool) to better understand gender differences and adjust designs accordingly.
- In societies with very restrictive norms and weak government commitment or capacity, identify those areas that are already within women's ability to engage, work with these areas to improve their productivity and benefits.

Highlights included:

- **Helping research and development practitioners understand the social context:** based on detailed research in Western Nepal, Leder Clement and Karki (2017) find that the poorest women did not benefit from programs aimed at providing them access to water for domestic and productive purposes. They conclude that water security programs must use more nuanced and context-specific understandings of women's empowerment – including caste, age, and family composition and positioning. In central India, a qualitative analysis of gender and inclusion within a watershed project revealed that when implementing watershed projects in a highly patriarchal context, it is critical to sensitize project staff on gender issues in order to deliver more systematic and gender-sensitive institution building, engagement and capacity development. The analysis highlighted how deeply rooted norms continue to exclude women from watershed-scale interventions (to be published in 2018). In West Africa, research demonstrated that despite many agricultural tasks being male ventures, women play an important role in mediating water conflicts, and their role in sustainable natural resource management must not be underestimated.
- **Challenging gender paradigms and thinking out of the box**: A review of large irrigation initiatives in the Gangetic plains shows that they are not tackling the huge gender inequalities, despite contrary claims from the donor and government and increasing feminization of agriculture in the region. A WLE policy brief makes recommendations on how local institutions should adjust their approaches to better accommodate social changes, while another brief lays out solutions such as supporting women's organizations and favorable grant conditions for

women. In another brief, the researchers argue that the Green Revolution has negatively impacted the poorest communities of Northern Bangladesh and that solutions to addressing poverty and gender inequality require new thinking, such as non-farm employment opportunities (decentralized agro-industries, garment industries etc.).

- **New tools to better understand gender dynamics:** Theis et al. (2017[3] explored the gendered consequences of the use of irrigation equipment through gender-disaggregated focus group discussions in Ethiopia, Ghana and Tanzania. The authors developed a framework that analyzes intra-household gender dynamics to better understand who uses and manages the technology, controls its outputs and decides on its sale or rental. Such comprehensive analyses should help anticipate and reduce gendered challenges in adoption. An Innovation Lab for Small Scale Irrigation (ILSSI) policy note published in 2017, "Integrating Gender into Small-Scale Irrigation", lays out a series of steps that investors can take to help ensure that women benefit equally from small-scale irrigation technologies. Actions must focus on increasing awareness of the benefits of the technology; reducing constraints around trying out the technology; and offering support for continued adoption. Finally, the Gender in Irrigation Learning and Improvement Tool (GILIT), described in WLE's 2016 Annual Report was released in 2017 after being tested in Malawi and Uzbekistan. The interest generated by these products resulted in an invitation to present on the topic at a USAID Agrilinks seminar "Can small scale irrigation empower women?" with WLE–LWS researchers.
- **Gender impacts of rural migration:** the MARIS (Migration, Agriculture and Resilience Initiative for Sustainability) network was launched, and has a growing membership. Led by IWMI/WLE, MARIS catalyzes research collaboration on migration, agriculture and resilience. MARIS associated itself with two events: a joint IWMI-MEDA (Mennonite Economic Development Associates) session on women in family farms at the Women's Economic Empowerment Forum in Bangkok; and a migration and resilience policy dialogue at the [CBA11 youth summit] in Kampala to link the research carried out in Asia with that of East Africa. In addition, a stakeholder consultation was held in Kampala on Migration, Youth and Agricultural Transitions: Emerging Perspectives, Global Linkages, and researchers came together to discuss what migration means on the home front, which was covered in local Nepali media.

1.3.2 Youth

Youth is a growing priority research theme, integrated with the work on gender, especially in the context of MARIS work on migration. A pilot study, linked to Flagship 1 on land degradation, was carried out on land restoration and youth engagement in Ethiopia and Kenya, and the results will be used in a comparative study on youth and gender in agricultural out-migration in Asia and Africa, which is to be finalized in 2018. A session at the aforementioned CBA11 youth summit in Uganda was crucial both to gather youth voices relating to agriculture and climate change, and place these on policy agendas. This conference has debunked another myth, at least for Uganda: contrary to the usual claims, most Ugandan youth are interested in agriculture and agricultural enterprises. However, they need more practical skills, access to land and finance, and mentoring. Nearly 80% of Uganda's population is under 30 years old, but unemployment for youths aged 15-24 is 83%.

1.3.3 Other Aspects of Equity / "Leaving No-one Behind" [4]

WLE's work to date on equity is largely reflected in the sections on gender and youth.

[3] Subsequently published in 2018 in Agriculture and Human Values.
[4] https://unstats.un.org/sdgs/report/2016/leaving-no-one-behind

1.3.4 Capacity Development

WLE's capacity building strategies go beyond 'training' and incorporate an understanding that sustainable capacity changes also need to be supported through long-term relationships, advising decision makers, institutional strengthening, and building a capacity to innovate. WLE continues to support the capacity of future scientists through long and shorter term training, but this is becoming less of a primary focus, noting the results of the 2017 CGIAR Evaluation on Capacity Development, which suggested the CGIAR comparative advantage is at a higher level, given limited funding resources.

Capacity development is an essential part of WLE's strategy, and therefore how to most effectively invest is an area that WLE reviews on a regular basis. Based on data submitted through MARLO, at the time of submission, WLE reports a total of 355 people benefiting from long-term training, and 257 people in short-term training – 35% of the latter figure being women. These are the figures given in Table D-1 (Indicator C4). Based on reports below, it is clear that the number of people trained under WLE is much higher, however as MARLO is being piloted this year as a tool for such data collection, it has not been possible to harvest this data thoroughly. Capacity development has also been described in section 1.2 when necessary to illustrate Flagship progress. Selected key highlights of capacity development initiatives throughout WLE's work include:

- **Specialized training packages:** WLE bolstered its work on landscape restoration (see 1.2, Flagship 1) and agricultural water management (see 1.2, Flagship 2) with training individuals and developing training materials on specialized issues, as well as developing targeted short courses to bolster skills and relationships. Key highlights included:
    - CIAT/WLE together with ISRIC trained 15 experts in May 2017 in Namibia on advanced assessment methods for assessing/baselining soil organic carbon, as part of its engagement in the UNCCD Land Degradation Neutrality (LDN) baseline mapping. CIAT/WLE also supported the Ethiopian SLMP through training of 200 people and supporting four MScs and two PhDs.
    - ICRAF/WLE provided training to countries implementing new soil spectroscopy and mapping tools, including: ICRAF's Soil-Plant Spectral Diagnostics Laboratory training 334 visitors, 22 intensive training participants, and supporting 11 MSc/PhD studies (7 MSc: 5 males, 2 females; 4 PhD: 3 males, 1 female).; and on-site training on soil-plant spectral methods for AfSIS partner institutes in Ghana, Malawi, Ethiopia and Tanzania, as well as the Indian Institute of Soil Science in Bhopal, and Rothamsted Research in the UK.
    - In southern Africa, the SADC GMI (Groundwater Management Institute) adopted a training manual on Integration of Groundwater Management into Transboundary Basin Organizations in Africa, developed by a consortium of partners including IWMI and GRIPP partners.
    - WLE/IWMI, in collaboration with UNE, developed a 90-minute webinar on SDG 6.6 was also developed and presented and is now available on the UN Water Web site. A special session was organized at the International Symposium of Remote Sensing of the Environment, for Ramsar, on "Wetland's Monitoring" (May 2017).
    - A senior IWMI/WLE researcher gave lectures in Germany: (i) ZEF doctoral courses; and (ii) at the PAUWES Summer-School, 'Coping with the Impact of Climate Change in Managing Water Systems' organized by ZEF and UNU. In collaboration with ZEF, a module on water management was developed for a course prepared for practitioners on landscape based approaches to natural resource management.
    - Around 10,500 farmers in Karnataka received training on the use of drip irrigation.

- Multiple training courses were held on resource, reuse and recycling approaches with Sri Lankan local authorities (231 participants), Kenya refugee settlements, India (150 master trainers) and Ghana (100 farmers).

- **Curriculum development and use:** WLE supports curriculum development for tertiary and vocational training programs implemented at institutional and individual level, including with NARES (see 1.2, Flagship 2) and through the work on resource reuse and recovery (see 1.2, Flagship 3), where IWMI/WLE is transforming it RRR knowledge base into multiple curricula, including modules for existing Massive, Open, Online courses (MOOCs) for students in developing economies. The WLE Greater Mekong research for development program on water governance[5], has also run a discrete capacity building initiative whose emphasis is not on advanced university degrees, but rather, small short duration (one year) grants to Mekong-based individuals to carry out research on a topic relevant to the program's objectives. WLE Greater Mekong concludes that its four fellowships projects have augmented its research in the region as a result of the networks that these fellowships then bring. There are currently 55 fellows. Women account for 58% of them, while 44% of fellows are from Myanmar, 33% from Vietnam, and the remainder are Thai, Lao, Chinese, Cambodian and a single international fellow.

- **Institutional development:** WLE has also started engaging more with international and regional institutions to provide advice and support on managing critical natural resource, climate and environmental challenges.
  - IWMI/WLE trained experts from water and climate agencies in the Association of Southeast Asian Nations (ASEAN) region during the Regional Workshop on Building Drought Resilience in Agriculture Partnerships and Outreach in Thailand, on drought preparedness and risk mitigation strategies. The work builds on WLE's contributions to drought prediction and management, including the Index Based Flood Insurance program and drought surveillance. This is the beginning of an important capacity building platform that will work towards continuously updating and expanding its knowledge base.
  - IWMI/WLE assisted the Asian Development Bank (ADB) to develop the '2016 Asia Leadership program on Sustainable Development and Climate Change' by contributing specific e-learning modules. IWMI/WLE also led a Nepal Irrigation Department institutional capacity development effort supported by the Asian Development Bank (ADB).
  - IWMI/WLE supported Innovation Platforms in irrigation schemes, Integrated Assessment Tool (IAT), participatory game playing (see 1.2, Flagship 2). They add to WLE's repertoire of methodologies developed with and for partner institutions aimed at helping people think out of the box around water sharing and efficiency. The Gender in Irrigation Learning and Improvement Tool (GILIT), described in WLE's 2016 Annual Report, was released in 2017 after being tested in Malawi and Uzbekistan.

1.3.5 Open Data

WLE has been putting in place a decentralized approach in which WLE partners manage their own data and data storage. WLE is working on aggregating and harvesting data from these existing data sources, using a simple and easily accessible system.

[5] Source: Greater Mekong Program. 2018. Fourth Progress Report to DFAT, April 1 2017 to March 31 2018. Unpublished.

WLE has been developing a data platform, meant to allow access through one portal, while sharing data across partner centers and the CGIAR platform. WLE has begun collecting metadata and datasets from researchers to populate the platform, and will be aligning strategies with partners. Development of the portal has been a challenge technically and resource-wise, and WLE is discussing possible adjustments to this strategy with the Big Data Platform and IWMI.

WLE follows all policies and procedures of the lead center (IWMI) on Intellectual Assets (IA) management and information, and knowledge dissemination to ensure compliance with the CGIAR Principles on the Management of Intellectual Assets and global Open Access. WLE Partner Agreements contain clauses on Intellectual Assets that are in compliance with the CGIAR Principles on the Management of IA.

As in Table D-1 (Indicator C5), WLE supported 82 peer-reviewed publications in 2017, of which 26 (54% of those indicated) were identified by partners as openly published. We expect this to be higher, but partners have not yet supplied open access information, due to their various capacities for tracking. Altmetrics scores (C6 and spreadsheet) showed some publications with notable attention, most prominently an article on the potential of soil carbon for climate mitigation in Nature Scientific Reports which received a score of 292, as it was supported through presentations at large events, media outreach and interviews, blogs and an infographic. As C5 and C6 are new indicators this year, systems will be improved for tracking throughout 2018.

1.3.6 Intellectual Assets

As per WLE communication with the SMO, Table E in the CRP annual reporting template for 2018 relates only to patents or PVPs, and WLE has no content to report for 2017.

WLE follows IWMI procedures and policies on IA, as mentioned in 1.3.5.

2. CRP Effectiveness and Efficiency

2.1 Variance from Planned Program

As noted above, Flagship 5 ESA has been revised extensively for 2018. Please see 1.2 for details **on** new directions and plans. Other flagship variances include:

Expanded research areas

RDL. RDL carried out a literature review on soil organic carbon in agricultural systems of East Africa, which was finalized and submitted for publication in an international journal in early 2018. RDL obtained funding from the Swedish government (AgriFoSe program) and hired two young female African scientists, Dr. Sara Namirembe and Dr. Beza Tessema.

RDL increased our engagement with the private sector and established contacts with impact investors for developing bankable land restoration investment portfolios (P421). We believe that these types of (co-)financing mechanisms are key to accelerating the implementation of land restoration in Africa. The Kenya county government of Makueni and the regional government of Amhara (Ethiopia) have expressed strong interest in receiving scientific (assessment, targeting and mapping of suitable SLM practices) as well business advice for developing finance and implementation plans for land restoration in their regions.

LWS. LWS is working more closely with partners in Ethiopia and India through a small amount of new funding, though most support is still from various IFIs.

RUL. Under CoA 2, RUL plans to work more on capacity development and opportunities to apply our lessons to refugee and host communities. Related proposals are in work or have been submitted.

VCR. VCR expanded work on Nexus activities in the Mekong region with a focus on basin dialogues for cross-sectoral solutions in the 3S basin; and for work on environmental flows and some additional small groundwater projects. This was supported through funding from the US Department of State.

Research lines dropped or cut significantly

RDL. RDL intended to work extensively with the Kenyan government. This has only been partly achieved, e.g. via our engagement in the Nairobi Water Fund and our presence in the Kenya working group of AFR100. Instead, RDL focused our attention on developing land restoration investment portfolios at the Kenya county level (see previous paragraph), namely Makueni, Laikipia, Bungoma, Siaya and Kakamega, Here, the interest in moving this topic ahead is more pronounced, and we believe that in this way chances of success are higher.

LWS. Collaboration with FAO occurs on an ad hoc basis, largely through secured project funding, LWS in-kind contributions to high-level consultations and meetings, and some publications (due in 2018). However, it has been harder to develop a systematic partnership as had been expected.

RUL. The bilateral CoA1 pipeline did not crystallize as planned, which will affect the number of cities WLE will work within. CoA1 needs some further adjustment around how to achieve the expected impact. Also, some of the gender work was not completed in time, and has been moved to 2018. Reasons for delays include a combination of gaps in staff expertise and reduced W1/W2 funding.

VCR. In 2016, VCR started contributing to an initiative to assess water-energy-food nexus issues to address risks and enhance resilience around the upscaling of a long-term CIMMYT conservation agricultural program (CASI) implemented by the Wheat and Maize CRPs. In 2017, VCR began discussions to develop a workplan with CIMMYT around the CASI technology in the Eastern Gangetic Plains, with special attention to gender. However, changes in the leadership of the full proposal prevented this work from going forward beyond an initial understanding that a larger-scale WLE-type assessment might support scaling of agricultural field-scale technologies.

Unexpected research results and directions

RDL. RDL made significant progress with research on the assessment of soil degradation status by mid-infrared spectroscopy (MIRS) and are now in a position to determine promising soil indicators using this technology; indicators such as the labile part of organic matter ("Soil Permanganate Oxidizable Carbon [POX-C]) in the soil that rapidly reacts to management changes. However, it is the indictors themselves that so far have shown very limited "indication" of the actual degradation of tropical soils. This is surprising, as these indictors had been tested and proven successful in a range of studies in temperate regions. This unexpected result requires expanding our research by sampling further regions and agro-ecosystems, which we have started in 2017 by sampling soils in Ethiopia using bilateral funds (BMZ).

LWS. LWS is focusing on business models in solar (pv) irrigation from emerging markets, meeting a growing interest in sound and sustainable business models for medium and large scale irrigation revitalization.

VCR. The development of an energy checklist for irrigation systems requested by the ADB with a pilot case study of Vietnam was welcomed by the ADB energy and water leaders and led to a request to apply the list to two further pilot countries (Bangladesh and Pakistan).

Work under the Bridge Collaborative that focuses on aligning agendas, finding cross-sectoral solutions across the health, development and environmental space led to an invitation by the Rockefeller Foundation to submit a proposal on the impact of synthetic proteins on food security and the environment. This is but one activity where WLE has been called to increasingly develop linkages between ecosystem health, food production or systems and human well-being. Other work includes linkages between environmental management of water-related diseases, such as malaria or

water pollution and human and planetary health. Finally, WLE was asked to identify linkages between agricultural water management and nutrition.

2.2 Use of W1/W2 Funding

WLE's W1/W2 funding is used to ensure programmatic integration and enhanced strategies for uptake and impact, with a particular focus on gender and cross CRP partnerships in 2017. W1/W2 funding made up 20% (USD 7.5m) of WLE's total expenditure in 2017, with 80% (USD 29.5 m) of program funds from W3/bilateral sources. Table J shows the breakdown of funding sources per Flagship. W1/W2 funds were used in the following strategic areas for WLE in 2017:

International policy engagement for greater results leverage. WLE has deployed W1/W2 to support integration of policy-ready research findings into relevant processes to influence decisions. Examples in 2017 include VCR at UNFCCC, IPBES, Ramsar and RDL's work on soil carbon feeding Koronivia Decision on Agriculture deliberations. The use of W1/W2 to disseminate and promote the latest findings in global fora and international events on land restoration, such as RDL at the Global Landscapes Forum, Global Soil Week, and the Global Soil Partnership, AFR100 and 20x20 has enabled CIAT/WLE to become officially recognized technical partner in AFR100 and 20x20, two crucial catalyzers of large-scale land restoration and thus implementation of SDG 15.3 (Land Degradation Neutrality).

Enhancing partnerships along impact pathways. Strategic gaps along the impact pathway, can occur between individual projects over time. W1/W2 plays an important role as strategic 'glue' between these initiatives, or supporting exploration or expansion into new areas, but it is only deployed where there is a strong case for linking and/or continuing a research activity. For instance, in 2017, examples include building the portfolio of work on city region food systems, RUL has used W1/W2 to support additional cross-site analyses, and the participation of the RUAF Foundation in a wider set of urban stakeholder dialogues, than would otherwise have been possible. A continuing collaboration with FAO in support of the joint FAO-WLE AQUASTAT database on wastewater was also supported thus building and maintaining WLE's joint delivery partnership with FAO. Support to the GRIPP initiative has enabled this partnership to grow in size and influence.

Developing and piloting of new tools and approaches. W1/W2 funds also supported the further enhancement of research around new tools and approaches. For instance, on infrared and x-ray dry spectroscopy techniques, particularly in experimenting and testing out new analytical approaches, new approaches to dealing with uncertainty in for land restoration planning and monitoring. Or to reinforce ongoing research, such as LWS's work to develop business and investment models (e.g. on solar irrigation in Ethiopia, exclosures in Ethiopia), and promote market led approaches to increasing income and productivity (e.g. through PPPs in irrigation), and develop metrics and approaches for sustainable intensification at watershed scale (e.g. benchmarking irrigation reports, global data on soil moisture management). VCR developed new assessment techniques for flood insurance products, and finalized a global groundwater modeling tool. Similarly, W1/W2 funds were used to pilot the Underground Taming of Floods (UTFI) approach in a new country, Vietnam, and assess the benefits associated with the natural variability of flood pulsing, and carry out research on trade-offs between upstream hydropower or irrigation infrastructure, and downstream losses to flood based farming/fishing. VCR also supported the roll-out of SDG assessment and monitoring for sustainable water (via a case study in South Africa) and the development of metrics/indicators for evaluating progress toward SDG targets.

Innovative interdisciplinary research. Ongoing research projects (bilateral, W3 or other) sometimes pinpoint a critical gap in knowledge that could reinforce progress along the impact pathway but has not yet been undertaken. W1/W2 funding is used to fill such critical gaps often addressing a new challenge and requiring interdisciplinary approaches – e.g. RUL conducted research on crop and soil responses to recovered and recycled nutrient resources, whereas RDL looking at the links between soil biology and ecosystem services in Western Kenya by synthesizing interactions between

agronomic performance, soil health, and soil carbon dynamics – evidence on these links are still weak.

Gender integration. Ensuring gender sensitive and gender responsive approaches are deployed effectively across the WLE portfolio is an important area of W1/W2 investment. Some flagships have also commissioned additional gender studies using W1/W2. RDL has studied barriers and drivers of adoption in Africa of soil carbon conserving management practices, with an emphasis on women, as well as by assessing the impact of water conservation activities in the upper Tana Basin of Kenya on women's (dis)empowerment. LWS invested in a review of gender aspects of India watershed investments.

Capacity building. W1/W2 has played an important role for RUL in enabling the translation of tried and tested research outputs into learning modules and summaries of our RRR business models for wider dissemination. RDL has also developed training modules for developing capacity of soil information services of African governments and the private sector on new technologies, in this case soil-pant spectral diagnostics methods for assessing soil health and targeting of interventions for soil fertility replenishment. W12 also supported capacity development for incorporating malaria control into planning and managing water infrastructure in Africa.

Synthesis, communication and dissemination. Using W1/W2 to promote research findings to a wider range of audiences is a means of reinforcing the impact pathway. RUL supported as set of special sessions and seminars at the Stockholm Water Week (as part of the Wastewater theme in 2017) as did LWS. RUL also commissioned a set of strategic RRR reviews and reports. VCR used W1/W2 funds to develop syntheses for outreach, and to act as a resource for the development of global documents on sustainable water such as the G-20 agricultural ministers' statements in 2017), as well as to participate in the development of the research agenda of the Knowledge Action Network on the Water-Energy-Food Nexus under Future Earth. W1/W2 also contributed to the FAO Land and Water Division collaboration on the background report on the state of land and water resources (due in 2018) and two joint contributions on climate change and water management in agriculture based on LWS work (to be published in 2018). LWS specific outreach events took place as joint center efforts: the International Commission on Irrigation and Drainage (ICID) 24rd Congress; and the 3rd Global Food Security Conference.

2.3 Key External Partnerships

Flagship 1 (RDL):

Key external implementation partners of the RDL flagship are the *Sustainable Land Management Program* (SLMP) in Ethiopia; the GIZ *Soil Protection and Rehabilitation for Food Security* program (GIZ Soil Program) in Ethiopia, Kenya, India and Benin; various implementation partners (CIPAV Foundation, Sinchi Institute, UNAMAZ) in Colombia and Peru; as well as a range of national agricultural research centers/institutes in the six priority countries. In addition, we collaborate closely with various national universities on research aspects and capacity building. These partnerships are crucial for pursuing our impact pathway. One highlight in 2017, was the recognition of the WLE framework to facilitate implementation of landscape-level interventions in Ethiopia by SLMP and the subsequent request to "automate" the framework and build national capacity towards its implementation.

In terms of global engagement and influencing/guiding the policy agenda towards land restoration, RDL key partners are the AFR100 and 20x20 Initiatives. A highlight of 2017 is the official recognition of CIAT/WLE as a technical partner in both these Initiatives. CIAT/WLE is also a member of 4p1000 Research Coordination Group. Here, we intend to intensify our engagement and visibility, as 4p1000 is becoming a widely recognized policy vehicle towards mainstreaming soil carbon sequestration for climate change mitigation. In addition, ICRAF became a member of the Committee on Science and Technology (CST) of the UNCCD, which provides an excellent opportunity to contribute to

strengthening land restoration science, especially in support of the Target Setting Program of the Land Degradation Neutrality Framework, to which 110 countries have signed up.

Flagship 2 (LWS):

FAO collaboration: To strengthen the LWS Phase II partnership with FAO, LWS has supported various activities and dialogues. For example, IWMI/WLE has been instrumental in a dialogue with FAO-MENA and Asia activities around solar pump development for smallholder irrigation and contributed to FAO workshops**.** LWS has also co-funded (with FAO) the development of a joint FAO/IWMI publication--a research report on the state of land and water resources that support agricultural production systems in Asia (and the Pacific) – to be published as a background document for the *FAO 34th Regional Conference for Asia and the Pacific 2018*. In addition, IWMI supports the LWS FAO partnership through ongoing W3-funded activities including 'WLE in Africa' undertaken in six Sub-Saharan (SSA) countries to scale AWM for smallholder irrigation, and a project to apply WA+ tools, methods and capacity development activities to assess water productivity in view of SDG target 6.3 (Ethiopia, Mali, and elsewhere in SSA). FP 2 works with a variety of international and national research partners, as well as development partners such as IFAD and the EC, a selection of which are highlighted in Table G below.

Flagship 3 (RUL):

A key outreach partner and co-lead of the Rural-Urban Linkages (RUL) flagship is the RUAF Foundation, whose support to WLE draws on (a) the RUAF partner network, (b) the networks and events which RUAF is leading or co-convening like the Urban Food Forum and the CITYFOOD network (both in collaboration with the International Council for Local Environmental Initiatives (ICLEI), or the Mayors' Summit of the Milan Pact and the Food for the Cities Programme (both as partner of FAO). A significant benefit offered by the RUAF partner network is its geographical scope, covering North and South. This allows cross-regional learning.

In RUL's CoA on RRR, a traditional partner has been FAO which is reflected in several joint publication (two in 2017) and a joint wastewater database under AQUASTAT. WHO (World Health Organization) is another important partner -- several WLE staff serve in expert groups. New partnerships are being explored with business and engineering schools (IHE, CEWAS, AIT, Makerere University, SANDEC, University of South Carolina, etc.) in support of innovative curricula building the WLE's work on business models for RRR.

Flagship 4 (VCR):

Key VCR partners include private sector partners, such as the Agency Insurance Company India (AICI) and SwissRe insurance company and the Indian Centre for Agricultural Research (ICAR) in India to support the piloting of the flood insurance product, government partners interested in better management of climate extremes, such as floods and droughts, such as the governments of various Indian states and Sri Lanka. Government agencies are the main end users of energy modeling tools and the primary recipients of capacity building on energy modeling to support water, energy and food security goals.

VCR also works with networks of researchers, such as the Knowledge Action Network on the Nexus of Future Earth, ICSU and the Food, Energy, Environment and Water Network. These networks are of particular use to jointly develop tools, pilot the tools and help ensure a wide application of jointly developed tools. Other important partners include multilateral agencies, such as the Asian Development Bank and the World Bank who aim to incorporate VCR results into their guidance and tools for task team managers. The VCR-led GRIPP network now comprises 29 academic and non-academic partners promoting sustainable groundwater use from local to global scales.

Key uptake partners include river basin organizations in Africa and Asia including the Nile Basin Initiative, the Niger Basin Authority, the Volta Basin Authority and the Tana & Athi Rivers

Development Authority. In Southeast Asia, VCR continues to support the Mekong River Commission Secretariat.

Flagship 5 (ESA):

As indicated in the updated Flagship 5 structure accepted in 2017, external partnerships complement the closer links made with agri-food systems and integrating CRPs (see Table H). World-leading partners engaged on decision analysis and model development include Hubbard Decision Research; Risk Information Management Research Group at Queen Mary's University of London, King's College, and the Center for Development Research (ZEF) at the University of Bonn. Other research partners in 2017 include Wageningen University (farming systems modelling) and the Université de Ouagadougou (low cost social and environmental monitoring tools). FP5 has engaged with SNV, TNC, and EAT, amongst others on outreach and development, and the Australian Department of Foreign Affairs and Trade, Australia (DFAT) has remained a champion for the ongoing water governance work in the Greater Mekong.

2.4 Cross-CGIAR Partnerships (other CRPs and Platforms)

WLE has continued to further and foster new partnerships with other CRPs. These are described in full in Table H. These collaborations fall into the following categories:

- *Responding to new demands for knowledge on specific inter-CRP areas:* e.g. initiating work with A4NH on links between water, food and disease; and with FISH on how to better exploit opportunities for integrated fish and water management; and providing advice on soil health to MAIZE.
- *Advancing understanding of new approaches to integrated natural resource management:* e.g. improving the evidence on potentials for carbon sequestration through rangeland management with LIVESTOCK, and on circular economy approaches such as the use of wastewater in aquaculture with FISH.
- *Delivering insights on wider scale impacts of crop and farm level interventions on wider sustainability (i.e. landscape levels):* e.g. working with GLDC to identify complementarities, working with LIVESTOCK on fodder value chains, looking at gender issues in index based flood insurance schemes with CCAFS.
- *Pooling evidence across CRPS for greater policy engagement and influence*: collaboration goal for upcoming tracking, as per 2018 Plan of Work and Budget.

2.5 Monitoring, Evaluation, Impact Assessment and Learning (MELIA)

In 2017, WLE conducted at the project level two important evaluations, an *ex-post* impact assessment, an adoption study and several other learning activities (see Table I-1). These MELIA activities will contribute to a more ambitious CRP-led set of stage 2 outcome studies in 2018. At the CRP level, WLE will also utilize these studies as inputs to a CRP-Commissioned External Evaluation in 2018 (providing that IEA guidelines remain consistent).

An *ex-ante* assessment of sustainable land management options was started in 2017 and will be completed by December 2018; it will be published as a book chapter. This is based on research in the Nairobi Water Fund area. WLE continues to monitor ecosystems service improvements in upstream restoration pilots and engages with the private sector to justify upstream land restoration investment portfolios. Examples are ASAS Dairies (Tanzania), Solidaridad, and F3Life.

2.6 Improving Efficiency

N/A

3. CRP Management

3.1 CRP Management and Governance

Phase 2 became fully operational, with arrangements remaining largely as described in the proposal and 2017 POWB, with IWMI, IFPRI, ICRAF, ICRISAT, CIAT and Bioversity represented on the Management Committee (MC). The WLE PMU led the redevelopment of FP5, resulting in its approval for CGIAR funding from 2018. The lack of funding for coordination of FP5 has been a challenge; with the PMU already having scaled down due to the overall reduced level of funding for the program. WLE's Gender Youth and Inclusion Coordination role was taken on part way through 2017 by Liza Debevec on an interim basis, while a recruitment process is ongoing for a permanent replacement (50% shared position with IWMI).

The Independent Steering Committee (ISC) held its first meeting with the two new representatives from CGIAR partner Center Boards, Barbara Schreiner and Brent Swallow. IWMI's new Director General, Claudia Sadoff, took her place on the WLE Independent Steering Committee (ISC) in October 2017.

3.2 Management of Risks to Your CRP

In 2017, IWMI updated its Risk Management procedures, in line with CGIAR policy. According to the new IWMI Risk Management structure, WLE monitors risks based on four categories: 1) Research and Science; 2) Financial Risk; 3) Infrastructure and Capability Risks; and 4) Reputational Risk. In late 2017, WLE categorized and ranked inherent and residual risk levels, and identified appropriate actions. Of 15 risks identified, two were considered high. One of these was financial, relating to a potential W1/W2 funding cut, with mitigation measures put in place including scenario planning for 2018 and a process for dealing with reductions. The second was reputational, relating to a bilaterally funded initiative, which had some partnerships challenges that now have been resolved.

Of the residual risks, ten are minor and five are moderate – none are considered to be high risk. Two risks classified as moderate continue to prove challenging and require further attention: i) the strain on PMU staff resources required to manage FP 5; and, ii) the risk of lower than expected delivery on gender targets. The approach to staffing FP 5 is now under review, with remedial options to be developed for approval. On gender, significant progress has been made in late 2017 and early 2018 to put in place gender focal points and gender work plans for each Flagship. Although recruitment of a program level Gender, Youth and Institutions (GYI) coordinator has taken slightly longer than expected, WLE aims to have an appointed GYI coordinator by August 2018. A third area of reputational risk, related to inherent challenge of ensuring that WLE's niche is clear and reflects the 'sum of its parts'. This is subject to concerted, ongoing efforts to improve through planning, management and communication. Other moderate risk areas relate to funding, for which a partnerships and fundraising plan is being developed.

3.3 Financial Summary

WLE's total expenditure in 2017 was USD 7.5m W1/W2 (20%) and USD 29.5m Bilateral/W3 (80%) funding. WLE therefore raised an additional $4m in bilateral funds raised compared to the POWB budget. A cut to W1/W2 funding was confirmed late in 2017 from the planned $7.9m, resulting in a need to make these cuts very late in the year. Further details can be found in the Financial summary provided in Table J, extracted from WLE's audited 2017 year-end report.

TABLES

Table A: Evidence on Progress towards SLOs

Table A-1: Evidence on progress towards the SLOs (sphere of interest)

In most cases, WLE will focus scarce resources on outcome level studies, in addition to the planned impact assessments list in table A-1. Over the next three years, WLE will conduct up to six outcome studies that focus on achieving results within our 'sphere of influence'. Impact assessments present some challenges to NRM. The impacts are often diffuse, or arise over longer time scales, and so evaluators working in the field of natural resources management and ecosystem services typically find it difficult to define "NRM technology" and "adoption clearly". Impact assessments that utilize experimental or quasi-experimental designs are rarely suitable for NRM, which use a broad range of knowledge-intensive and site-specific management principles that often employ a combination of modern inputs and technologies best suited to a particular context.

SLO Target (2022)	**Brief summary of new evidence of CGIAR contribution to *relevant* targets for this CRP (with citation)**	**Expected additional contribution before end of 2022 (if not already fully covered).**
1.1. 100 million more farm households have adopted improved varieties, breeds, trees, and/or management practices	No new evidence in 2017	Theis, Sophie; Lefore, Nicole; Meinzen-Dick, Ruth Suseela; and Bryan, Elizabeth. What happens after technology adoption? Gendered aspects of small-scale irrigation technologies in Ethiopia, Ghana, and Tanzania. Agriculture and Human Values. Article in press. First published online on April 25, 2018. This study examines post-adoption of agricultural technology from a gendered perspective. By understanding better intrahousehold distribution of costs and benefits, technology promotion can be designed to increase scaling impacts. Meinzen-Dick, Ruth Suseela; Janssen, Marco A.; Kandikuppa, Sandeep; Chaturvedi, Rahul; Rao, Kaushalendra; and Theis, Sophie. 2018. Playing games to save water: Collective action games for groundwater

		management in Andhra Pradesh, India. World Development 107 (July 2018): 40-53. This W1/W2 WLE study used collective actions to assess impacts on groundwater stewardship. After the games were played, a significantly higher proportion of communities adopted water registers and rules to govern groundwater, compared to other communities in the same NGO water commons program. Balasubramanya, S. 2018. Farm participation in water user associations in Southern Tajikistan: effects of longer training and the role of gender. In review at *Agricultural Economics.** Buisson, M.C, Balasubramanya, S. 2018. The effect of water governance and agronomic training on crop choice in Tajikistan. In review at *Land Use Policy.**
1.2. 30 million people, of which 50% are women, assisted to exit poverty	No new evidence in 2017	Bryan *et al*. Irrigation and Gender: Women's Empowerment and Decision-Making in Water Management Practices in Ethiopia, Tanzania, and Ghana. This study may also contribute to SLO targets 1.1, 2.1, 2.2 and 3.1.
3.1. 5% increase in water and nutrient efficiency in agroecosystems	New evidence based on data from 141 Water Users Associations in Tajikistan indicates that with longer training, WUAs perform mandated functions better than those with shorter training. In particular, WUA's recovered membership fees from 19% more of members; were 10% more likely to hold board meeting for planning activities before the start of the irrigation season; and carried out routine repairs and maintenance of irrigation canals more frequently. Balasubramanya, S., Price, J. P. G., & Horbulyk, T. M. (2017). Impacts Assessments without True Baselines: Assessing the Relative Effects of Training on the Performance of Water User Associations in Southern Tajikistan. Water Economics and Policy, 1850007.*	Mekonnen *et al*. Small Scale Irrigation, Women's Empowerment, and Women's Time Use: Evidence from an RCT in Northern Ghana Haile *et al*. Constraints and opportunities for adoption of small-scale irrigation technologies. Evidence from East and West Africa

3.2. Reduction in 'agriculturally'-related greenhouse gas emissions by 5%	No new evidence in 2017.	
3.3. 55 M ha degraded land area restored	No new evidence in 2017.	
3.4. 2.5 M ha forest saved from deforestation	No new evidence in 2017.	

* These IA's focus on a USAID funded initiative. They provide WLE with important learning data relevant to SLO targets.

Table A-2: List of New Outcome Case Studies from This Reporting Year (Sphere of Influence)

The following is a list of WLE's 2017 outcome case studies. Full details are provided in the full case studies, including reference to cross cutting dimensions and specific areas of success.

Title of outcome case study	No. of Sub-IDO	Links to evidence*	Space for additional, very brief details, including on cross-cutting issues
Ethiopia adopts WLE research findings to improve the returns on its massive investments in soil and water management	1.1; 1.2; 3.1; 3.3	https://marlo.cgiar.org/projects/WLE/study.do?edit=true&expectedID=2204&phaseID=13&crp=WLE	In 2017, the Ethiopian Prime Minister approved a policy to make all agricultural water technologies tax exempt. Ethiopia also adopted a new Soils Strategy to target soil fertility management interventions in various landscape niches; and the Sustainable Land Management Program (SLMP) began adopting new techniques to target interventions at different landscape levels following community-led processes. These outcomes are a direct result of WLE research, capacity strengthening and policy engagement in Ethiopia.
Evidence-based soils agronomy for raising crop production in Africa	3.3; 1.1	https://marlo.cgiar.org/projects/WLE/study.do?edit=true&expectedID=2205&phaseID=13&crp=WLE	Suite of innovative rapid and low-cost decision-support tools for soil and plant analysis, using spectral diagnostic techiques and datasets produced through the Africa Soil Information Service (AfSIS) with strong WLE support, has been used by governments and investors in 14 countries to make more effective decisions on soil management and soil enhancement
Sri Lankan sanitation policy adopts recycling of septage for reuse as fertilizer	3.1	https://marlo.cgiar.org/projects/WLE/study.do?edit=true&expectedID=2206&phaseID=13&crp=WLE	WLE research fed the development of Sri Lankan government's sanitation policy, including septage management in the policy, and incorporating options for recycling and reuse of septage into safe organic fertilizer.

*Please submit outcome case studies in MARLO, MEL or other MIS, and provide links, using the outcome case study template.

Table B: Status of Planned Milestones [6]

	Mapped and contributing to Sub-IDO	2022 CRP outcomes[7]	Milestone	2017 milestone status	Provide evidence for completed milestones** or explanation for extended or cancelled
1	Increased resilience of agro-ecosystems and communities, especially those including smallholders	1.1 Better-informed landscape restoration policies, approaches and interventions	Knowledge products used by national governments or regional stakeholder platforms supporting implementation of innovative restoration pilots as well as national conservation and restoration planning in Kenya and Ghana.	Ongoing	The work of WLE and partners in Northern Ghana is embedded in the Savannah Accelerated Development Authority (SADA) stakeholder platform. WLE's research and engagement with platform stakeholders covers a range of issues including bringing in women and vulnerable groups into decision making on land and water resources. WLE continues to be present in the Upper-Tana Nairobi Water Fund, which provides opportunities to support restoration pilots. To enhance efficiency and reach, WLE decided that the most appropriate entry point for policy influence in Kenya is through county governments, with work with the Makueni well underway and initial links made with Laikipia, Bungoma, Siaya and Kakamega. Also in Africa, a WLE informed stakeholder platform on land restoration generated a soil and water management action plan in Tanzania; and restoration pilots were implemented in Ethiopia, with a review to be published in 2018.
			Private sector companies or foundations active in land restoration request WLE support for developing an investment-ready business portfolio.	Ongoing	WLE has started - and will continue - to engage with the private sector to build bankable land restoration investment portfolios. Examples are ASAS Dairies (Tanzania), Solidaridad, and F3Life. A key focus for 2018 is the development of a business case for land restoration of Makueni county in Kenya, to attract public-private investment
			Further investments made in land restoration pilots as a result of demonstrated improvements in ecosystems services provision.	Complete	The Packard Foundation approved an investment for land restoration piloting in Oromiya, Ethiopia

[6] These milestones are taken from the 2017 POWB. It was not intended that all milestones would be fully completed in 2017, rather that the processes would be initiated. Therefore we have added the status annotation "Ongoing" for milestones that were not due for completion in 2017. WLE's results framework is under review, to improve on the clarity of milestones and outcomes.

[7] As part of WLE's results framework review, the wording of outcomes has been adjusted for clarity. As noted in the narrative, outcome 3.3 has been removed from WLE.

					A high level US delegation visited the Jordan watershed restoration project, which evaluates land restoration impacts on ecosystems services on soil and vegetation, with a view to future investment
1	Reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use	1.2 Policies, strategies, and interventions investing in practices that rehabilitate or protect soil fertility and soil carbon	Kenyan county governments of Kakamega, Siaya and Bungoma consider including methodological guide on estimating and measuring soil carbon at various scales into their soil and landscape restoration planning and monitoring.	Extended	WLE is in contact with national partners, NGO, as well as county government officials from these three counties. WLE researchers interact through 1:1 meetings, official workshops, field days, and by email. WLE has have developed an online tool for assessing carbon and other soil fertility properties. This work will extend into 2018.
			Two UNCCD LDN participating countries of the humid tropics request support for further advanced methods (such as mid-infrared spectroscopy -MIRS) for determining soil degradation status into their list of LDN progress monitoring indicators.	Complete	Assistance has been provided to Ghana and Nigeria to set up national soil information systems (GhaSIS, NiSIS) based on mid-infrared spectroscopy. Both countries have large-scale soil surveys and agronomic trials in progress to diagnose soil degradation and crop nutritional deficiencies using the new technology. WLE has also been involved in collaboration and training of Namibian UNCCD LDN scientists on digital soil mapping.
			Increased visibility, reach and influence of WLE-RDL at the level of national and international platforms, such as AFR100, 20x20, GLF, 4p1000, and within the UNCCD and UNFCCC COPs.	Complete	WLE/CIAT has become an official 20x20 and AFR100 technical partner, and supports Kenyan county governments in restoration planning (see outcome 1.1). Increased visibility has also been achieved via active involvement in GLF-Bonn 2017; the FAO GSP Global Symposium on Soil Organic Carbon; and UNCCD COP13

	Increased capacity of partner organizations as evidenced by rate of investments in agricultural research	1.3 Strengthen approaches to the monitoring and evaluation of land restoration and the assessment of land degradation risks	Framework paper presenting a new analytical approach for planning and performance management of land restoration initiatives integrating feedback from testing with development partners.	Extended	Working papers on testing the framework with stakeholders (IUCN, Technoserve) were published (Probablistic Decision Modelling, Marsabit; DryDev's effectiveness through Probabilistic Decision Modelling; Valuing ecosystem services in rangelands through stochastic simulation). The main framework paper was submitted for publication and is under review.
			Partnership with government and development agencies in Kenya and Tanzania produce data sets from multi-location agronomic trials demonstrating a soil-plant ionomics approach using dry spectral technology for predicting crop nutrient constraints.	Extended	For Tanzania, samples have taken in One Acre Fund trials and TanSIS crop surveys. Sample analysis is in progress and preliminary data sets have been generated for Kenya.
2	Reduced smallholders production risk	2.1 Policy and practice informed by more effective agricultural land and water management solutions and investment options	Phase 1 business models reviewed (and as appropriate adapted/ adopted) public/private sector agencies in 6 countries	Ongoing	This milestone covers several stages of progress, towards which the project is on track. Three business models will be published in 2018: Exclosures in Ethiopia, and solar pump based irrigation in Ethiopia and Ghana.
			Phase 1 recommendations on ALWM interventions evident in policy, investment and/or development programs in 3 countries: Ethiopia, Ghana and India	Ongoing	A number of recommendations have been incorporated into policy and development programs e.g. Tax Exemption on irrigation equipment (Ethiopia); Soil fertility maps (Ethiopia); Government of Uttar Pradesh (India) has requested WLE partners to scale up pilots on integrated agricultural water management techniques across the state. In Ghana there have been requests for further support from various stakeholders, including from the Ministry of Agriculture on conservation agriculture; from a Danish pump company considering market expansion and from iDE.

	Agricultural systems diversified and intensified in ways that protect soils and water	2.2. Improved management of new and revitalized medium to large scale irrigation schemes	Farmers, scheme managers, investors and policy makers in medium and large-scale irrigation systems, request LWS-influenced new technologies and management approaches to improve productivity and income generation (targeting Zimbabwe, Nigeria and Myanmar)	Ongoing (Nigeria cancelled)	In Myanmar, LIFT asked WLE to research if there are business models that could make wetting front detector technology accessible. Supermarket chain Metro sought knowledge from WLE researchers as to whether farmers could supply consistently high value crops e.g. chillies, to customers in Yangon. The Myanmar Irrigation and Water Management department has stated a wish to scale the institutional innovations that are being piloted in the Pyawt Ywar Pump Irrigation Project. In Zimbabwe, after initial delays due to government restructure, work has now started Matabeleland north and south. Planned work in Nigeria with the World Bank was cancelled.
			Identify how problematic large and medium scale irrigation schemes (LSIS) in 3 countries (India, Ethiopia, Egypt) can be improved by benchmarking tools, PPP arrangements and supporting capacity building needs in private and public irrigation sector	Extended	Research and capacity development by WLE to improve water productivity using a new technology (wetting front detectors) in the 6000h irrigation scheme in Koga, Ethiopia, is ongoing. In Egypt, extensive research has been conducted into management practices in the irrigated areas of the Nile Delta, which is being analysed and finalized for future use to support policy and practice to target improvements in agricultural water productivity and water use efficiency.
3	Conducive agricultural policy environment	3.1.Increased capacity and evidence for male and female stakeholders and policy makers to implement urban and peri-urban agriculture related policies and farming system innovations	Led by its agencies 8 cities have implemented in-depth analysis on their food value chains and farming system for capacity development and policy advice.	Ongoing	In 2017, City Region Food Systems (CRFS) assessments were completed in Colombo and Quito, with further assessments under way in Nairobi, Tamale, Quagadougou, Cali, Medellin and Toronto. Assessments were based on stakeholder consultations and focused on the analysis of the whole CRFS, or a particular foodshed, urban agriculture, value chains or food security indicators based on the Milan Urban Food Policy Pact.
			4 cities have (gone a step further and) adopted a monitoring system for UPA/CRFS related innovations and development of food related indicators, policies and/or actions.	Ongoing	The 4 cities of Cali, Quito, Nairobi, and most recently, Palmira, are being assisted in their work on CRFS indicators for progress monitoring and urban food security/safety strategies or policies. The city of Quito is in the process of developing its own territorial food strategy. With support from RUAF/WLE, the city agreed to define key indicators for each of the pillars of the food strategy. In 2017, a very first draft of the indicator framework was formulated. Support has been provided to Nairobi to a similar level (to be reported in 2018).

	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	3.2 Increased business capacities in nutrient, water and energy recovery from domestic and agro-industrial waste for intensified food crop production	Field trials for waste-based soil rehabilitation established for major plantation crops in Sri Lanka targeting recommendations for private sector investments on e.g. 180,000 ha under tea	Extended	Two MoU's with the private plantation sector (Mike Flora (Pvt) Ltd. and Horana Plantations PLC) have been signed followed by the set-up of field trials for testing WLE recommendations in Sri Lanka.
			Business models (18) for resource recovery from fecal sludge promoted through the design of a free Massive Open Online Courses (MOOC) for entrepreneurs of both gender across Africa, Asia and Latin America, and support of start-ups on fecal sludge mgt. in India	. Extended	The RRR business modules on fecal sludge have been designed and submitted to the MOOC operating agency (SANDEC) which is working on their integration in the existing fecal sludge management MOOC. Once the WLE modules have been integrated, they should appear as part of the course, here. WLE partner CEWAS, which specializes in start-up support, translated our latest research findings into a curriculum which will be tested in 2018.
			Advisory services to ADB and World Bank in Nepal and India for adoption and replication of resource oriented solid and liquid waste management in small towns with potential to impact about 300,000 people.	Extended	WLE advised ADB on the construction and business models for fecal sludge management for two towns in Nepal. Based on our advice, the designs were modified and tendering was done for the construction. A Greywater guidance note was developed for World Bank staff use in India. Similar advisory activities continue in 2018[8].
			Guidelines developed for the Indian Ministry of Urban Development on safety handling of fecal sludge and wastewater to be applied in ca. 8000 towns with potential to impact several million people	Extended	A wastewater guidance note was developed for the Indian Ministry of Housing and Urban Affairs in collaboration with the World Bank. This is awaiting finalizing following structural changes in the Ministry. This activity has been supported by pilots for sanitation for low-income communities in Delhi; business models for RRR/solid waste management in Maharashtra, and training of trainers and support to state strategies on Solid, Liquid and Fecal Sludge Management in so far 9 villages of Uttar Pradesh, Bihar and Jharkhand state.

[8] Documents relating to Advisory Services (feasibility studies, guidance notes) are internal and therefore not in the public domain.

4	Enhanced capacity to deal with climactic risks and extremes	4.1 Risks associated with water variability mitigated	Flood insurance theoretical and institutional framework and tools (with insights for more equitable risk sharing for women) delivered to government partners and insurance companies (co-developed with CCAFS)	Extended	This milestone has been extended as a result of a delay in making insurance payouts in Bihar. WLE produced a technical brief, "Reducing vulnerability among smallholder farmers through index-based flood insurance in India: equity matters" that made some progress towards the milestone. Furthermore, key results of the gender and equity survey from Bihar was presented along with the overall IBFI project findings at a policy dialogue workshop on flood insurance and drought management.
			Preliminary drought monitoring framework established and available to FAO and partners in Southern Africa.	Complete	The preliminary framework for Southern Africa is complete.
			Workplan with selected AFS CRPs to support ex-ante analyses of water variability developed	Cancelled	Some discussions occurred with CIMMYT, custodian of the Wheat and Maize CRPs, to understand groundwater challenges underlying the production systems of the Eastern Gangetic Plains. However there was no funding available to pursue this.
4	More productive and equitable management of natural resources	4.2 Uptake of solutions and investment options better able to address tradeoffs across competing water-energy-food needs	Increased capacity in basin agencies for better management of combined portfolios of natural (green) and built (grey) infrastructure in the Volta and Tana basins to build greater resilience and enhanced ecosystem services.	Complete	This WISE-UP project, led by IUCN, increased understanding of the inter-linkages between natural and built infrastructure in two river basins (Volta and Tana), within government and also non-government organizations. This was achieved through action learning meetings which highlighted the importance of working through and understanding trade-offs in order to identify sustainable development pathways in the light of climate change.
			Methodology for the assessment of key targets under SDG 6 [water] and interlinkages developed.	Complete	In conjunction with UNE, WLE developed guidance on indicators for SDG 6.6.1 and a draft paper on SDG6 interlinkages with other SDG goals and targets completed using the ICSU framework that was also co-developed with WLE.

	Reduced smallholders production risk	4.3. Increased public investments into, and adoption of WLE policy advise on aligned water-energy-food nexus strategies at various scales, including for groundwater challenges	Establishment of operational partnerships in the WLE Groundwater Solutions Initiative for Policy and Practice (GRIPP) Initiative	Complete	WLE made progress in terms of consolidating and extending GRIPP through new partnerships, bringing the partner total to 29.
			Information on risks and opportunities associated with groundwater use applied and taken up with key Government partners in India and elsewhere.	Extended	In Lao PDR, the first national hydro-geological map and dataset were handed over to the Groundwater Division of the Department of Water Resources, for use in national groundwater planning and management (Groundwater in Laos paper). More trials in India confirmed that additional volumes of water stored in the aquifer do bring benefits for farming households.
			At least 2 water-energy-food nexus initiatives and national strategies are informed by WLE technology, policy and institutional insights	Complete	The Knowledge Action Network of Future Earth issued a development strategy that was informed by WLE activities. The Nile Basin Initiative invited WLE researchers to put together the first Nile Basin Economist Workshop in May 2017, based on the economic modeling analysis of water-energy-food nexus tools. The Asian Development Bank requested guidance on how to ensure that irrigation modernization and rehabilitation projects are not only effective but are also energy-efficient. A national scale (Ethiopia) energy modelling study was published, followed by policy and capacity building events on energy supply and demand modeling in response to requests from the Ethiopian Ministry of Water, Irrigation and Energy.
	Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	5.1: Decision makers are better able to access relevant evidence, tools and expertise to design and manage natural resource management (NRM) and	Redesigned Flagship submitted for approval taking into consideration reviewer comments	Complete	The redesigned WLE Flagship 5 was approved by the CGIAR/ ISPC in November 2017.
			Results from bilateral projects incorporated into the redesign of Flagship 5	Complete	The redesigned WLE Flagship 5 was approved. This document and the subsequent 2018 workplan incorporated bilateral project results including building on the range of decision support and decision analysis tools; ecosystem service modeling using different approaches at scale, and synergy and trade-off analysis of management interventions. Case studies will focus on existing research, likely to focus on Uganda, Ethiopia, South East Asia.

		agriculture programs that deliver more effectively against multiple SDG targets across scales	Evidence on specific ecosystem based approaches, such as agrobiodiversity conservation, generated	Complete	Evidence is being generated by a series of bilaterally funded initiatives, e.g. on the development of methods that support agro-biodiversity inclusion in local and global land use management decisions. Comprehensive review undertaken of integrated landscape initiatives in 16 countries across Asia illustrates that institutional and stakeholder capacity is key to success. Multiple methods for mapping small reservoirs were tested in the Volta Basin (Mapping Reservoirs; Big data and mapping small reservoirs). The developed Ecosystem Service maps can be applied to decisions on agricultural practices on landscape, watershed, and potentially global level.
	Agricultural systems diversified and intensified in ways that protect land and water	5.2: NRM and agricultural development programs that apply WLE approaches and use tools are more cost-effective and avoid negative trade-offs between SDGs across scales	Application of innovative decision-support tools applied across a sample of programs	Complete	An analysis of the impacts of agricultural policy on household nutrition was published. A decision analysis methods guide was produced on agricultural policy for nutrition. The MESH-SDG tool, designed to illustrate how changes in ecosystem services under alternative land use land cover conditions could impact on progress towards the SDGs was designed and tested in Honduras and Ghana. A study on heterogeneity in riverine ecosystem service perceptions: Insights for water-decision processes in transboundary rivers (IFPRI) was published, from which perceptions of ecosystems in the Indus, Mekong and Niger basins can help in understanding how decisions are taken. A spatially scalable, generalized agent-based modeling (ABM) framework was tested in the Mekong and Niger River basins, shedding light on holistic food-water-energy-environment management policies in these two basins. The Enabling Decision-Making for Agricultural Interventions tool integrates knowledge and systems thinking in making decisions for agricultural issues. This was applied to a case study in Lagdwenda, Burkina Faso and will be expanded to 3 other countries in 2018.

					A novel method to map reservoirs and quantify the uncertainty of Landsat derived reservoir area estimates (specifically from the Global Surface Water Monthly Water History (GSW) dataset) was tested on the Volta River Basin. This study provides guidance on the conditions with which GSW and other Landsat-based surface water maps can be used to accurately monitor reservoir resources.

Table C: Cross-cutting Aspect of Outputs

This optional table has been completed, however we urge caution when considering the results, for a number of reasons. First, many projects may have a large component which is cross cutting (e.g. gender) but when this is expressed (for the purposes of this task) as a proportion of number of deliverables, if there are a large number of deliverables, gender can appear insignificant, and can belie an otherwise significant contribution. Secondly, without clear cross CRP guidance, 0, 1 and 2 ratings will be applied differently across CRPs. Thirdly, the assessment of these cross cutting outputs has been difficult in the 2017-2018 planning cycle, since the definitions have changed from the 2017 to the 2018 POWBs. In 2017 it was intended to review the cross cutting contributions of *cluster level* outputs, of which there are generally only a handful per cluster. However, now that MARLO is in use, it is more logical to assess the contribution of deliverables, since there is direct evidence to link to each deliverable. To date, a satisfactory approach to planning and recording this information is lacking and WLE would be happy to contribute to further cross CGIAR thinking on this issue.

Cross-cutting	Number (%) scored 2 (Principal)	Number (%) scored 1 (significant)	Number (%) scored 0	Total overall number of outputs
Gender	3 (1%)	45 (17%)	219 (82%)	267
Youth	0	18 (7%)	249 (93%)	
CapDev	21 (8%)	76 (28%)	170 (64%)	

Table D: Common Results Reporting Indicators

Table D-1: Key CRP Results from 2017, in Numbers

Indicators C1- C4 are based entirely on data provided to WLE by project leaders, using MARLO. As MARLO was not designed to collect this specific data, and given that these needs were not a requirement when 2017 activities were plan, it is likely these indicators are largely underreported. This is to be addressed in 2018.

Sphere	Indicators	Data	Comments
Influence	**I1/I2*Projected uptake (women and men)/ha from current CRP investments**	New indicator being introduced in 2018.	New indicator: not recorded in 2017
	I3. Number of policies/ investments (etc) modified in 2017, informed by CGIAR research	1 The UNFCCC Conference of the Parties formally recognized that increasing soil organic matter puts carbon back into the soil and hence can help mitigate climate change	1. WLE's contribution was to demonstrate potential for, and benefits of, carbon sequestration through publication in high impact journals and a major outreach campaign (see FP1 narrative).
		2 The Ethiopian Prime Minister approved a policy to make all water technologies tax exempt.	2 Director of Household irrigation at the Ethiopian Agricultural Transformation Agency, stated by email that IWMI's review of irrigation technology adoption and a 2012 review of the national pump supply chain (under WLE Phase I) influenced this change in policy. The ATA has requested WLE support to assess the impacts of this policy change on smallholder farmers.
		3 WLE partners helped the Ethiopian Ministry of Agriculture and Rural Development develop a revised 'Ethiopian Soil Strategy', which is expected to be signed in 2018 by the minister	3. The contribution was made by WLE partners serving on a core advisory team.
		4 In the 2018 Budget Presentation to Parliament, the Indian Finance Minister pledged: US$7B to install grid-connected solar pumps with surplus power buy-back arrangements (building on the Dhundi Solar Project model) US$400M for groundwater irrigation in irrigation-deprived districts (building on ITP's review and recommendations for the Prime Minister's Krishi Sinchai Yojana)	4. The WLE- and CCAFS-supported IWMI-TATA Program recommendations reported in previous WLE Annual Reports were used in 2017 by the Government of India to design new investments in irrigation development.

Sphere	Indicators	Data	Comments
		5 The Sri Lankan cabinet approval of the National Sanitation Policy of Sri Lanka.	5. In a letter to the Director General of IWMI, the Ministry formally acknowledged IWMI's contribution to the policy on septage management and reuse. IWMI has been asked to support the policy implementation process.
Control	**C1. Number of innovations by phase - new in 2017**	Stage 1 (Discovery/Proof of Concept): 3 Stage 2 (End of Piloting): 2 Stage 3 (Available for uptake): 3 Stage 4 (Uptake by next user): 1	See Table D2. These examples have been provided on a voluntary basis during reporting, by project leaders. It is likely that the number of innovations is higher than this.
	C2. Number of formal partnerships in 2017, by purpose (ongoing + new)[9]	103 research partnerships 22 piloting partnerships 38 scaling up and scaling out partnerships 31 Not defined	This data is generated from MARLO and captures all unique project partners (formal and informal) that were entered into the system. This information is not complete because a) it only represents partnerships at project level (not flagship or program level) and b) not all project reporting data has yet been filled in on MARLO. Partners that fit more than one category are only counted once.
	C3. Participants in CGIAR activities 2017 (new +ongoing)	Participants: 1525 (30% women).	This number is based on evidence collected through MARLO and is does not represent the sum of all WLE activities. The number is derived from projects which have recorded participants at events include knowledge sharing workshops, forums, and focus groups. Participant types include farmers, policy influencers/ makers. MARLO does not disaggregate end users from next users. Female participation was not indicated/estimated for all events.
	C4. People trained in 2017	Long term: 355 (7%) One time event: 257 (35% women)	This data is preliminary. Many more trainees have been identified in narrative, but this figure captures only those submitted through MARLO. Female participation was not indicated or estimated for all training events.
	C5. Number of peer-reviewed publications	82 in 2017 [Full list of WLE publications] of which at least 26 (54% of those indicated) are confirmed by partners as openly published	Additional publications may be open, however partners did not supply a response for many publications. ICRAF did not submit data.

[9] Multiple purposes can be selected per partner in MARLO. Where this is the case, the lowest level of partnership is selected, to avoid double counting.

Sphere	Indicators	Data	Comments
		No data for open data base	Open database data figures are under development as partner centres were unable to supply data. Systems will be improved for tracking throughout 2018.
	C6. Altmetrics	See publication spreadsheet, (Reports generated by individual centers due to incomplete WLE mapping)	As this is a new indicator introduced this year, WLE has provided Altmetrics reports from IWMI and other partners, but note that data is incomplete and systems were not in place for reliable 2017 tracking.

*Please note: I = Sphere of Influence and C = Sphere of Control

Table D-2: List of CRP Innovations in 2017 (From indicator #C1 in Table D-1)

The following innovation examples have been provided on a voluntary basis during reporting, by project leaders, onto MARLO. It is likely that there is a higher number of innovations in WLE work which have not been reported, given that this is the first year this type of information has been requested.

Title of innovation (minimum required for clarity)	Phase of research *	Novel or adaptive research	Contribution of CRP (sole, lead, contributor)	Geographic scope: for innovations in phases AV* or USE* only (one country, region, multi-country, global)
Systems modelling (whole farm) as decision support evaluating impact of SLM strategies of household cashflows	Phase 1: End of research phase (Discovery/Proof of Concept)	Adaptive	Partial Contribution	Regional (Southern Asia)
Designing low cost water harvesting system for Bundelkhand region and rejuvenating Haveli system	Phase 1: End of research phase (Discovery/Proof of Concept)	Novel	Partial Contribution	Regional (Southern Asia)
Silvopastoral systems for degrading lands in the Colombian Amazon	Phase 1: End of research phase (Discovery/Proof of Concept)	Adaptive	Partial Contribution	National (Colombia)
Soil Data Manager	Phase 2: End of piloting phase	Adaptive	Partial Contribution	Multi-national (Burundi, Ethiopia, Kenya, Rwanda, Uganda, Tanzania)
Characterization of farms in terms of proximity to the natural state and in terms of their contribution to landscape connectivity	Phase 2: End of piloting phase	Novel	Sole Contribution	National (Cuba)

Online water planning tool for Honduras	Phase 3: Available for uptake	Novel	Partial Contribution	National (Honduras)
Mobile data entry for manual data	Phase 3: Available for uptake	Adaptive	Partial Contribution	Sub-national (Nepal)
'Contour bunding' preserves soils and boosts farmers' incomes by 20% in Mali – new study	Phase 3: Available for uptake	Adaptive	Partial Contribution	Regional (Western Africa)
Collective action games to strengthen resource governance	Phase 4: Uptake by next user	Novel	Partial Contribution	National

* Phases: PC - proof of concept, PIL - successful pilot, AV - available/ready for uptake, USE - uptake by next users.

Table E: Intellectual Assets

Following confirmation by the SMO that Table E relates to patents and PVPs, WLE does not have entries for this table.

Table F: Main Areas of W1/2 Expenditure in 2017

WLE has not completed this optional table, given that WLE partners did not collect this level of financial data for 2017 activities. A summary of how W1-2 funding was spent in 2017 is provided in the narrative, section 2.2

Table G: List of Key External Partnerships

The following are selected examples of 'important' partnerships, 5-7 per Flagship. This covers all categories of partner, not all of which are included in the partner list of over 195 generated by MARLO, most of whom are involved in implementation of WLE projects.

FP	Stage of research*	Name of partner	Partner type*	Main area of partnership*
1,2, 3,4	Phase 1, 2, and 3	The World Bank	International Finance Institution	FP1: Guidelines for incorporation of soil spectral testing in the World Bank Living Standards Measurement Study, piloted in Ethiopia and Uganda. FP2: Irrigation Benchmarking FP3:Water sanitation program FP4: incorporating VCR results into WB guidance
1	Phase 3	United Nations Convention to Combat Desertification (UNCCD)	International Convention	WLE (ICRAF) membership of UNCCD Committee on Science and Technology – support to target setting for LDN.
1	Phase 3	AFR100 and 20x20 Initiative	Regional Initiatives (Africa and Latin America)	Engagement in policy dialogue around land restoration; guiding, supporting and influencing the decision making process
1	Phase 2, 3	Sustainable Land Management Project (SLMP), Ethiopia	National Initiative supported by international donors and implementing agencies	Piloting and scaling of successful land restoration practices co-developed by WLE in Ethiopia
1	Phase 3	One Acre Fund	Nonprofit Organization	WLE's Soil and plant analysis support in One Acre Fund's on-farm trials in Kenya to guide fertilizer and liming recommendations.
1	Phase 2	The Center Foundation for Research in Sustainable Agricultural Production Systems (CIPAV), The Amazonian scientific research institute (SINCHI), Asociacion de Universidades Amazonicas (UNAMAZ)	Non-governmental organization	Implementing partner on land restoration within the Sustainable Amazonian Landscapes Program in Peru and Colombia
1, 2	Phase 2	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)	Development Agency	Joint work to share project results with stakeholders, policy makers. Partnerships with the GIZ Soil Protection and Rehabilitation for Food Security Program: Piloting of soil fertility and soil carbon enhancing technologies in Benin, Burkina Faso, Ethiopia, Kenya and India
2	Phase 1	Australian National University (ANU)	Academic and Research Organization	Leadership on projects, beneficiaries, out scaling

2	Phase 3/4	Commonwealth Scientific and Industrial Research Organization (CSIRO)	Academic and Research Organization	Joint work in Zimbabwe, and providing support to research teams in Tanzania and Mozambique with regards to innovation platforms.
2	Phase 3	Australian Center for International Agricultural Research (ACIAR)	Development Agency	Government partner that identifies key policy-relevant questions; provides entry to officials and irrigation projects
2	Phase 1, 2 and 3	International Fund for Agricultural Development (IFAD); European Commission (EC)	International Finance Institutions	Financial and technical support provided through 'WLE in Africa' initiative on Agricultural Water management in Africa, and Flood Based Farming systems in selected countries in Africa and Asia
2	Phase 3	International Commission on Irrigation and Drainage (ICID)	International Organization	Partner in Irrigation Benchmarking, irrigation asset management; convener of ICID congress
2	Phase 1	Institut d'Economie Rurale (IER)	Academic and Research Organization	Watershed management
2	Phase 1	Ethiopian Institute of Agricultural Research (EIAR), Bahir Dar University (BDU); University of Dar Es Salaam Mwalimu Nyerere (UDSM)	Academic and Research Organization	Research partners
3	Phase 1	Laurier University - Center for Food Systems (CSFS)	Academic and Research Organization	Partners with RUAF on city region food systems management
3	Phase 2, 3	Local Governments for Sustainability (ICLEI)	International Government Organization	Collaboration on Urban Food Forum and the CITYFOOD network
3	Phase 3	Bill and Melinda Gates Foundation (BMGF)	Development Agency	Support to RRR Public private partnership initiatives
3	Phase 3	World Health Organization (WHO)	Multilateral agency	WLE staff serve on various WHO expert groups
3	Phase 3	Jekora ventures ltd (JVL)	Private Company	Jekora works with WLE projects in Ghana developing Fortifier plants
3	Phase 3	International Centre for Water Management Services (CEWAS)	Nonprofit Organization	Partnership on curricula building for RRR business models
4	Phase 1	LeHigh university, University of Illinois at Urbana; Duke University	Academic and Research Organization	Joint development of research
4	Phase 2, Phase 3	Agency Insurance Company India (AICI); Swiss Re insurance company	Private Sector	Index Based Flood Insurance partners
4	Phase 1, 2	Indian Centre for Agricultural Research (ICAR)	Academic and Research Organization	Support to flood and drought monitoring research in India
4	Phase 2	Food Energy and Environment Water Network (FE2W); Future Earth's	Network of researchers and research organizations	Co-development of tools and piloting for wider application and uptake

		Knowledge-Action Network on Water Energy Food Nexus; International Science Council		
4	Phase 3	Asian Development Bank (ADB)	Multilateral agency	Development of tools for incorporation into ADB guidance
4	Phase 3	Ethiopian Ministry of Water, Irrigation and Energy	Government	Capacity building on energy systems modeling
4	Phase 3	Nile, Niger, Volta Basin Authorities; Mekong River Commission	Regional Agencies	Key partners on uptake across the portfolio
5	Phase 3	Department of Foreign Affairs and Trade, Australia (DFAT)	Development Agency	Ongoing support to regional water governance in the Mekong, focusing on bringing research into policy and development
5	Phase 1	Centre for Development Research (ZEF), University of Bonn	Academic and Research Organization	Partner on decision support, both on bilateral projects and in redevelopment of Flagship 5
5	Phase 1, 2, 3	The Nature Conservancy (TNC)	NGO	Leads BRIDGE collaborative
5	Phase 1	Kings College London (KCL), Hubbard Decision Research	Academic and Research Organization	Decision support tools
5	Phase 1	Wageningen University	University	Leading farming systems modeling work for sustainable agriculture diversification and nutrition.
5	Phase 1, 2 and 3	Université de Ouagadougou (UdO)	Academic and Research Organization	Leading research on water quality; Leading piloting of low cost social and environmental monitoring tools; Leading work to scale up monitoring tool uptake
5	Phase 1, 2 and 3	Netherlands Development Organisation (SNV)	NGO	Leading participatory research workshops; Piloting interventions identified through research phase; Leading knowledge-sharing workshops to share lessons learnt and enable similar interventions elsewhere
5	Phase 3	EAT	Nonprofit Organization	FP5 Researcher serves as the EAT Science Director, collaborating in ideas, papers, and outreach activities.

* See instructions in the common results indicators manual (available early 2018).

Table H: Status of Internal (CGIAR) Collaborations among Programs and between the Program and Platforms

Name of CRP or Platform	Brief description of collaboration (give and take among CRPs) and value added*	Relevant FP
A4NH	WLE FP3 (RUL) with A4NH FP5 identified potential for collaboration on water, agriculture, and infectious diseases. Explorative studies and joint publications came under discussion. A joint workshop at the Stockholm World Water week and a workshop on Agricultural Development and Disease Risk in a Changing African Landscape, Ghana are planned for 2018	F5 - Improving Human Health
CCAFS	WLE FP1 (RDL) collaborated with CCAFS on soil carbon sequestration and the 4 per 1000 initiative. WLE also integrated climate services information developed through CCAFS regional programs into WLE watershed and irrigation development initiatives in India, Myanmar, and Ethiopia, under WLE FP2 (LWS), which has also worked with CCAFS in solar irrigation development in Mali and in India (Gujarat) in the IWMI –TATA initiative. WLE FP4 (VCR) continued to collaborate with CCAFS on flood insurance in South Asia, investigating how to ensure equitable provision to men and women; and on Underground Taming of Floods – UTFI.	F2 - Climate-Smart Technologies F4 - Climate Services and Safety Nets F5 - Gender and Social Inclusion
FISH	IWMI participated in the FISH CRP Resilient Small-scale Fisheries Symposium (supported by ACIAR) in September 2017, to develop a synthesis of evidence of the impact of small scale fisheries research towards food and nutrition security, livelihoods and equity. IWMI presented on how fisheries productivity could be improved in constructed infrastructure associated with both the hydropower and irrigation sectors. A joint synthesis piece on this topic is being worked on, with FISH, FAO and WLE. WLE FP4 (VCR) subsequently cooperated with FISH FP1 to develop a research agenda on fish and water use in the context of multi-functional landscapes, developing a youth strategy for the FISH CRP. WLE FP3 (RUL) started a collaboration with FISH on wastewater aquaculture, which will be further developed during 2018.	FP1 – Sustainable Aquaculture FP2 – Small Scale Fisheries
FTA	WLE FP1 (RDL) worked closely with FTA CRP on the Global Landscapes Forum Initiative. IWMI/WLE also collaborated with CIFOR, ICRAF and the Wageningen Centre for Development Innovation and ZEF to offer the 'Think Landscape' course in December	
GLDC	WLE provided inputs to the re-design of GLDC and looking at how to align the field level research of GLDC with landscape-watershed activities in similar geographical areas (e.g. Mali, Niger, India)	
LIVESTOCK	WLE FP1 (RDL) joined forces to assess degradation status and carbon stocks of rangelands in Kenya and options for boosting carbon sequestrations through improved rangelands management. Discussions took place on livestock and water priorities between LIVESTOCK Flagship on Livestock and Environment and WLE FP2. Some work on small scale irrigation and fodder value chains took place.	
MAIZE	WLE FP1 (RDL) small assessment of risks and opportunities around upscaling of selected MAIZE technologies in the Eastern Gangetic Plains. Consultation took place on potential future engagement with FP5	

PIM	WLE FP4 (VCR) collaborated on joint development of diagnostic tools to assess gender issues in water management to support project design, MEL and the development of research questions. Together, we are jointly furthering the youth research agenda, considering a) active participation and/or exclusion of young people in land and water management, and b) youth aspirations/unemployment and the transition of many young people from agricultural to non-farm livelihoods, with implications for agricultural knowledge, rural institutions and long-term sustainability (Refer to Section 1.3.2] WLE and PIM have joint research on agricultural collectives in Nepal, building on existing WLE research to Improve Dry Season Irrigation for Marginal and Tenant Farmers, focusing on options for upscaling, and analysis of other initiatives in the region.	
RICE	Discussions took place with RICE and UNE-IRRI Sustainable Rice Platform to identify opportunity for cross-working on rice landscapes in context of FP5.	
RTB	Discussions took place between RTB FP5 and WLE FP5, with view to engaging with RTB in Uganda with FP5 in 2018.	
WHEAT	Consultation took place on potential future engagement with FP5	
CGIAR Big Data Platform	Consulted on data portal and received feedback on direction and data sharing.	
CGIAR Gender Platform	Seven WLE researchers presented their gender work across a range of WLE topics, at the CGIAR Gender platform Scientific Conference and Meeting in 2017, alongside the GYI Interim coordinator, who presented the WLE Gender strategy.	

*e.g. scientific or efficiency benefits

Table I: Monitoring, Evaluation, Impact Assessment and Learning

Table I-1: Status of Evaluations, Impact Assessments and Other Learning Exercises Planned in the 2017 POWB

The 2017 POWB did not specifically include planned evaluations, assessments and learning exercises. The following studies are extracted from the WLE MARLO database of 2017 deliverables and are included for information.

Studies/learning exercises in 2017	Status	Comments
Adoption Study: Adoption and economic impact of briquette as cooking fuel: the case of women fish smokers in Ghana	Completed	The study was done as part of the CapVal (Creating and capturing value) project looking at identifying potential market segments for briquettes and how the briquettes can benefit potential end users specifically women (publication forthcoming in 2018)
Impact Assessment: Impacts of Fortifer processing plant	Ongoing	This study (publication forthcoming in 2018) investigated the financial, environmental, health and some social impacts of the Fortifer processing plant in Greater Accra, Ghana.
Evaluation: Performance Evaluations of GFDRR-UK Aid Challenge Fund: Open	Completed	This evaluation was undertaken as part of the Global Facility for Disaster Reduction and Recovery's (GFDRR's) Innovation Lab.

Source, DIY Remote Weather Stations in Sri Lanka		
Evaluation: Mid Term Evaluation- Agrobiodiversity conservation and Man and the Biosphere (MAB) Reserves in Cuba: bridging managed and natural landscapes	Completed	Conservation of agrobiodiversity in reserves is a complex, new area of work for WLE. Yet this mid-term review shows that the team has made important efforts to integrate agrobiodiversity into MAB reserve management plans and encourage environmentally friendly farming practices in and around reserves. Such efforts are now being operationalized through the new Plan of the National System of Protected Areas 2015-2020

Table I-2: Update on Actions Taken in Response to Relevant Evaluations (IEA, CCEEs and Others)

This is not applicable for 2017

Table J: WLE Financial Report

All figures are provided in USD 000's

	Planned budget 2017			**Actual expenditure 2017***			**Difference**		
	W1/2	**W3/ bilateral/ Center**	**Total**	**W1/2**	**W3/ bilateral/ Center**	**Total**	**W1/2**	**W3/ bilateral**	**Total**
FP1	1,975	6,089	8,064	1,997	9,051	11,048	22	2,962	2,984
FP2	1,773	9,508	11,281	1,671	9,752	11,423	(102)	244	142
FP3	1,066	3,186	4,252	955	1,633	2,588	(111)	(1,553)	(1,664)
FP4	1,564	2,852	4,416	1,515	5,57	7,086	(49)	2,719	2,670
FP5	-	3,440	3,440	-	3,438	3,438	-	(2)	(2)
Mgt & Support	1,267	-	1,267	1,311	24	1,334	43	24	67
Total	7,645	25,075	32,720	7,448	29,469	36,917	(197)	4,394	4,197

*The source of this financial data is the 2017 WLE Year End Re