CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems

LED BY: IWMI International Water Management Institute

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Photo: Women's market in Ethiopia
Credit: Boru Douthwaite

Outcome Evaluation of the work of the CGIAR Research Program on Water, Land and Ecosystems (WLE) on soil and water management in Ethiopia

Evaluation report

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Acronyms and abbreviations

AoC	Area of Change
Africa RISING	Africa Research in Sustainable Intensification for Next Generation
AfSIS	Africa Soils Information Service
ARARI	Amhara Regional Agricultural Research Institute
ATA	Ethiopian Agricultural Transformation Agency
BMGF	Bill and Melinda Gates Foundation
CCAFS	CGIAR Research Program on Climate Change, Agriculture and Food Security
CGIAR	Consultative Group for International Agricultural Research
CIAT	Centro Internacional de Agricultura Tropical; International Center for Tropical Agriculture
COM-B	capabilities (C); opportunities (O); motivation (M); behavior (B)
CPWF	CGIAR Challenge Program on Water and Food
CRP	CGIAR Research Program
ET	Evaluation Team
EthioSIS	Ethiopian Soil Information System
FAO	Food and Agriculture Organization of the United Nations
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit; German Corporation for International Cooperation
GoE	Government of Ethiopia
ICRAF	International Centre for Research in Agroforestry, now the World Agroforestry Centre
ICRISAT	The International Crops Research Institute for the Semi-Arid Tropics
IFDC	International Fertilizer Development Center
ILSSI	Innovation Laboratory for Small Scale Irrigation
IWMI	International Water Management Institute
LIVES	Livestock and Irrigation Value chains for Ethiopian Smallholders
MoWR	Ministry of Water Resources
OICR	Outcome-Impact Case Reports
OT	Outcome Trajectories
RUAF	Resource Centers on Urban Agriculture and Forestry
USAID	United States Agency for International Development
WB AGP	World Bank's Agricultural Growth Program
WLE	CGIAR Research Program on Water, Land and Ecosystems
USAID	United States Agency for International Development

Glossary of terms

WLE Outcome	A change in the behaviour (practices, relationships) or policies (that influence behaviour) of individuals, groups, organisations or institutions that are influenced in a small or large way, directly or indirectly, intentionally or not, by WLE
WLE outcome trajectory	The pattern of interactions and causal links between actors that maintain and scale WLE outcomes over time
WLE area of change	A set of WLE outcome trajectories that share a characteristic by which the outcome trajectories can become more than the sum of their parts
Outcome trajectory champion	Someone who tracks an outcome trajectory and does what he or she can do to keep and build momentum. This commonly involves a set of activities that can be loosely described as 'networking'
Causal mechanism	Programs change behavior when people *make sense of* and use what programs provide. When successful in bringing about change, program intervention sets up and/or contributes to relatively stable and structured patterns of interaction between program outputs, people, organizations and institutions. These patterns deliver outcomes and are a type of causal mechanism. An outcome trajectory is the manifestation of one or more causal mechanisms working in a particular context.[1]

[1] For more on realist thinking, see Pawson, R. (2013). *The science of evaluation: a realist manifesto*. Sage

Executive summary

This summary extracts the conclusions and recommendations from an evaluation of the outcomes from the work of the CGIAR Research Program (CRP) on Water, Land and Ecosystems (WLE). It is intended to serve as a stand-alone summary, as well as to direct readers to a more detailed description of the methodology, evidence and findings in the main report.

WLE is a global research-for-development program connecting partners to deliver agricultural solutions that sustain our natural resources – and the people that rely on them.[2] The program is led by the International Water Management Institute (IWMI) and supported by the CGIAR, a global research partnership for a food secure future. WLE brings together 11 CGIAR Centers, the Food and Agriculture Organization of the United Nations (FAO), the RUAF Foundation, and national, regional and international partners.

Phase I of WLE operated from 2012 to 2016 as one of 15 CRPs established based on the foundational idea that all CGIAR research should be carried out within programs. WLE was successful in winning a second phase, that runs from 2017 to 2021.

WLE Phase 2 has been operating in a context of sharply reduced budgets. Donors lost confidence in CRPs as the main funding vehicles for research during Phase 1. From 2014 to 2017 funding for CRPs fell by nearly 60% from US$ 382 million to US$ 160 million. During the same period, funding to the CGIAR as a whole fell by 20%.[3]

WLE Phase 2 is organized around five Flagship Projects (FPs) together with a Gender Core Theme:

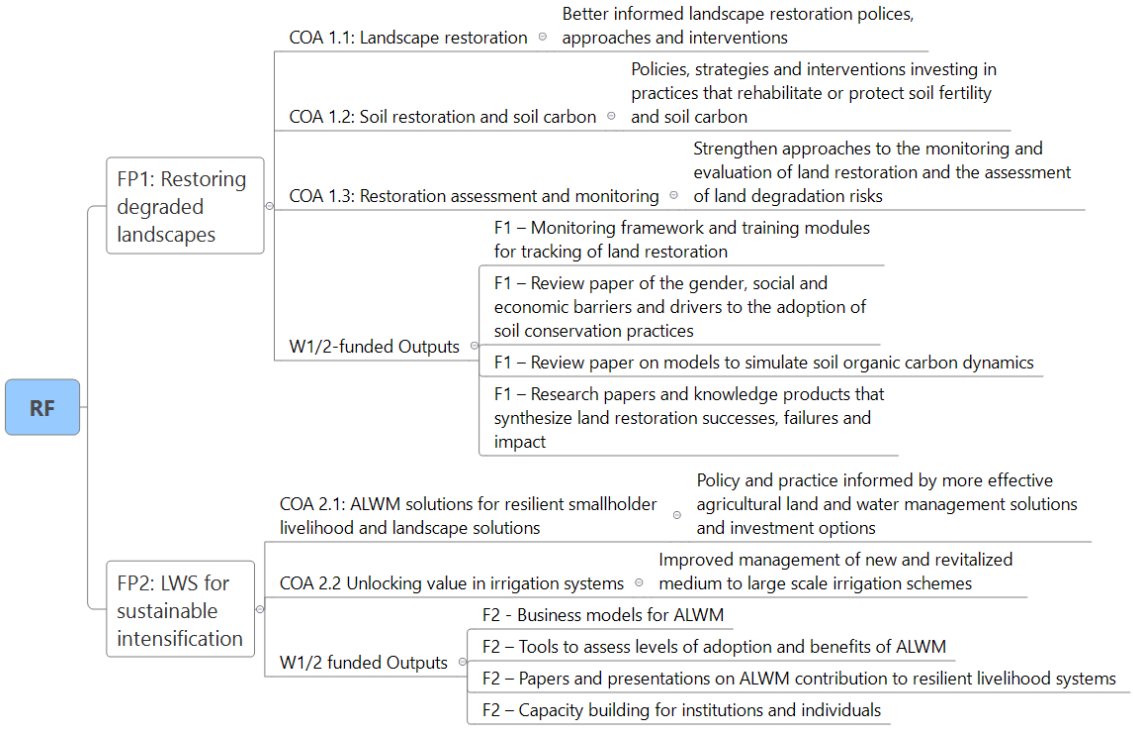
1. Restoring Degraded Landscapes
2. Land and Water Solutions for Sustainable Intensification
3. Sustaining Rural-Urban Linkages
4. Managing Resource Variability Risks and Competing Uses for Increased Resilience
5. Enhancing Sustainability across Agricultural Systems.

The FPs are thematically based, working in ten CGIAR target countries within four focal regions – Greater Mekong; Ganges; East Africa; and, West Africa.

In 2019, WLE commissioned a number of evaluations to help the program better understand the complex mechanisms that lead to long-term impacts at scale, of which this is one. WLE Leadership chose to evaluate WLE's work in Ethiopia as one of its countries where it has had most success, largely through the work of FP 1 and FP 2 summarized in Figure 1.

[2] https://wle.cgiar.org/about
[3] https://cgspace.cgiar.org/bitstream/handle/10568/97418/2017-CGIAR-Financial-Report-Web.pdf p.16

Figure 1: Results framework for FP1 & FP2



The main intended users of the evaluation are implementing staff and decision-makers in WLE, in particular, the WLE Management Committee. The secondary intended users are other stakeholders in WLE, including WLE investors, partners and the CGIAR System Organization.

The main objectives of the evaluation were:

1. To determine how and in what ways WLE contributed to the achievement of intended/unintended outcomes in Ethiopia;
2. Make recommendations of how WLE and its partners can become more effective;
3. To serve as a participatory learning experience for WLE and its partners.

Methodology

The evaluation addressed three evaluation questions:

1. What were WLE outcomes in Ethiopia and how did WLE contribute to them?
2. Did WLE help contribute to the design and promotion of research that considers gender or the needs of marginalized groups within its partner centers?
3. Are WLE outcomes likely to be sustainable over the long term?

The evaluation team (ET) used an adaptation of Outcome Harvesting.[4] The latter works by selecting outcome trajectories (OT) to which a program believes it has contributed and then evaluating

[4] Paz-Ybarnegaray, R. and Douthwaite, B., 2017. Outcome evidencing: A method for enabling and evaluating program intervention in complex systems. *American Journal of Evaluation*, *38*(2), pp.275-293.

whether it did, and how. An outcome is understood to be a change in the behaviour (practices, relationships) or policies that influence behaviour of individuals, groups, organisations or institutions. An outcome trajectory is pattern of interactions and causal links between actors that maintain and scale outcomes over time.

The ET worked with WLE's Ethiopia-based staff to identify 10 OTs they thought were significant. These were then described in a workshop in which the champions for each of the OTs were invited to describe the history of their respective OT. This was done through a participatory exercise involving developing timelines for each OT and presenting it to others to validate and add in their perspectives, given the OTs were interlinked and several participants worked on more than one OT.

After the workshop, the ET then further developed the timelines and verbal descriptions through field trips, key informant interviews and review of program documents. These were checked back with the main champions of each OT.

The ET grouped the OTs into three areas of change (AoC) according to the main causal mechanism driving them. The OTs and the three theories of change developed for each of the AoCs were used to answer the evaluation questions.

Table 1: WLE outcome trajectories grouped by areas of change investigated by the evaluation

Areas of change and outcome trajectories	**Lead Center**
Area of Change 1: Through demonstrating landscape approaches	
1A. Farmers benefiting from the development of multifunctional and resilient landscapes	CIAT
1B. Farmers improving their soils and water supply in the Yewol Mountains	ICRISAT
1C. Dryland pastoralists engaging in agriculture by harnessing floodwaters	ICRISAT
Area of Change 2: Through use of geospatial data	
2A. Soil-plant spectral technology guiding soil fertility investments in Ethiopia	ICRAF
2B. Ethiopia adopts a new soil strategy to target soil fertility management interventions in various landscape niches	ICRISAT
2C. Contribution to the Ministry of Agriculture approving a soil and agronomy data sharing policy key to agricultural transformation in Ethiopia	CIAT
2D. Ministry of Agriculture makes an inventory of the area under irrigation in Ethiopia	IWMI

Area of Change 3: Through transformative use of technology	
3A. WLE contribution to the Prime Minister of Ethiopia approving a policy to make all agricultural water technologies exempt from taxation	IWMI
3B. Pilot schemes of climate-smart water lifting technology led to large-scale public investments in solar-powered irrigation practices	IWMI
3C. Harnessing Ethiopian floodwaters at landscape level helps dryland pastoralists	ICRISAT
3D. Ecological footprint of food security: mapping irrigated area in Ethiopia	IWMI

Conclusions

The conclusions are derived from the main findings derived from tackling the evaluation questions, written up in the main report.

1. On the scope of and magnitude of WLE Outcomes in Ethiopia

The ET find the scope and potential magnitude of ten Center/WLE outcome trajectories (OTs) impressive for an annual investment of less than US$ 6 million. Currently, some OTs are contributing to farm households in the low thousands adopting new and improved technologies and management practices. This is however, very far from the WLE target to reach 1 million households in Ethiopia by 2022. The OTs have the potential for such reach, but only after much more time, and only if the OTs work together in three areas of change identified by the evaluation.

Conclusion 1: On how WLE contributed to the outcome trajectories

WLE contributed to the OTs by developing research outputs, such as business models or soil maps, which acted as 'boundary objects'[5] to bring different stakeholders together to maximize their use and usefulness within the OT.

WLE also created an enabling environment for a WLE-Ethiopia approach based on 'impact tracking.' Impact tracking involves senior Ethiopian-based researchers using their professional networks to establish and move the OTs forward, using a set of behaviours akin to 'product championing.'

Conclusion 2: On the sustainability of the outcome trajectories

The OTs are likely to persist and develop because they are highly relevant to the development needs of Ethiopia. Construction of causal models (i.e., theories of change) for each of the three AoCs indicates positive feedback loops based on causal packages that build capabilities, create opportunities and motivate target groups to change their behaviors. The behavior change motivates others to learn about the change and replicate it themselves. Impact tracking by OT champions that

[5] See https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2663982/ for more on boundary objects

are attuned to emerging opportunity is an important part of the OT causal package. None of the OTs can run by themselves without some degree of subvention.

Conclusion 3: On the risk of promoting promising innovations too soon and too widely

Part of the WLE-Ethiopia approach is to work closely with government partners and the existing extension system. There are good reasons for doing this, not least to ensure local- to national-level reach and ownership, and the potential to go to scale quickly. A risk, though, is that technologies will be pushed too early and too widely before the longer-term biophysical and social consequences become evident. There is also a risk of being overly cautious and missing opportunities when they present themselves.

Conclusion 4: On how WLE engendered the outcome trajectories

The most engendered outcome trajectory (OT-3.3 on exclosures) was the one which WLE had provided the majority of the funding, and therefore presumably could exert the most influence. Elsewhere, Center/WLE gender research, and guidance derived from it, struggled to change practice on the ground, despite efforts to do so that were successful in other countries. A question for WLE to consider is whether there might be an inevitable trade-off about working as part of a top-down extension system (see the previous conclusion) and addressing social inclusion issues, particularly those at intra-household level.

Conclusion 5: On missed opportunities for synergies

WLE core partners in Ethiopia are competing with each other because of a difficult funding environment for the last four to five years, despite WLE's efforts to incentivize collaboration in other ways. Competition is not conducive to synergistic research, and there is some evidence that it has deterred donors. Senior Ethiopia-based researchers are aware of synergies and want to collaborate, as they have in the past. They ask that WLE play a role in making this happen.

Conclusion 6: On who should play the 'site integration' role for WLE research in Ethiopia

Stronger site integration would help WLE core partners in Ethiopia to collaborate more. Senior core partner researchers remember that they were able to work together more synergistically under the CGIAR Challenge Program on Water and Food (CPWF). Compared to CPWF, WLE has less funding, lacks a common geographic development challenge and does not have a country-level coordinator to ensure site integration. WLE should manage expectations as to how much integration it can be expected to deliver, while working more closely with other organizations better placed to play the role, as explored in Recommendation 3.

Conclusion 7: On the use of an 'outcome trajectory' as a metaphor in the evaluation

The concept of an outcome trajectory (OT) proved useful as a metaphor to help understand the contribution that WLE research has made to WLE outcomes. An OT is a slowly changing pattern of interactions between actors that deliver a stream of outcomes to those involved over time. The metaphor matches well the notion of impact tracking (see Conclusion 9) to ensure an OT keeps momentum and direction. The metaphor brings with it the useful idea of a history, or path dependency, in which what has happened before influences what is happening now and will happen in the future.

Also useful was the idea that OTs can be clustered together according to a common causal mechanism, and that this 'area of change' has a greater potential than any OT by itself. The validity of this was evident in AoC-2 where three OTs, led by three different Centers, were seen to be contributing to a greater whole, one which could save Ethiopia billions of dollars through more efficient use of fertilizer.

Recommendations

Recommendation 1: WLE-Ethiopia to keep doing much of what it is already doing

Given the impressive scope and potential magnitude of WLE outcomes, WLE-Ethiopia should better appreciate what it is doing well, and do more of it. This will include continuing to contribute to the ten OTs identified, identifying those that the evaluation may have missed, and starting new ones through good science and process facilitation. Specifically, the ET suggests that regular After-Action Reviews are carried out for each OT based on developing and revisiting timelines (similar participatory learning dynamic to the outcome evidencing workshop for this evaluation). This will allow WLE-Ethiopia staff and stakeholders to review, reflect and respond in ways that will allow WLE to exert maximum leverage with the resources it provides.

Given the importance of partnerships in the OTs, and the idea that no one organization can do it all, the WLE CGIAR Centers should become better at acknowledging the contribution of others, including the contribution of WLE. Specifically, the ET suggests developing a 'code of conduct' for acknowledging each other's contributions.

Recommendation 2: For WLE-Ethiopia to build on the concept of 'impact tracking' with support from WLE-Global

The emergent WLE-Ethiopia approach of 'impact tracking' described by key staff during the evaluation should be systematized and promoted as an international public good, applicable to other programs seeking to trigger major change with relatively little funding. Specifically, the suggestion is to publish the approach in a journal such as Agricultural Systems, Tropical Agriculture or Research Evaluation.

Recommendation 3: For WLE leadership to improve collaboration between WLE CGIAR Centers working in Ethiopia

The suggestion is that WLE identifies and selects to work on one or two synergies believed by the staff to have the greatest potential. For example, WLE could choose to support CIAT and ICRISAT to develop a common WLE-branded landscape/watershed approach.

WLE should also better acknowledge and strengthen the integration role that others are playing in Ethiopia, including Africa RISING, GIZ and ATA in the three respective AoCs. WLE leadership should question the assumption that CGIAR centers should be the ones deciding how they collaborate in a particular country. An argument can be made that these decisions should be taken by implementing agencies functioning as boundary organizations[6] across the research – policy divide. Boundary organizations bring researchers together with policy and development actors to carry out collaborative work that has strong lines of accountability to both research and development. CGIAR Centers struggle to function as boundary organizations because they are much more accountable to research than development.

[6] For more on boundary organizations, see https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2663982/

1. Introduction

Purpose of the evaluation

The CGIAR Research Program on Water, Land and Ecosystems (WLE) is a global research-for-development program connecting partners to deliver agricultural solutions that sustain our natural resources – and the people that rely on them.[7] The program is led by the International Water Management Institute (IWMI) and supported by the CGIAR (formerly, Consultative Group for International Agricultural Research), a global research partnership for a food secure future. WLE brings together 11 CGIAR Centers, the Food and Agriculture Organization of the United Nations (FAO), the Resource Centers on Urban Agriculture and Forestry (RUAF) Foundation, and national, regional and international partners. WLE carries out its research through five Flagships (see Figure 1).

In 2019, WLE commissioned three evaluations of which this is one. The other two are an evaluation of the Resource Recovery and Reuse Flagship and an evaluation of WLE's and CGIAR Research Program on Climate Change, Agriculture and Food Security's (CCAFS) work on solar pumping in India. WLE plans to commission more evaluations in 2020. The purpose of the evaluations is to facilitate learning and demonstrate how WLE activities can add value to catalyze change.

Intended users

The primary intended users are decision makers in WLE, in particular, the WLE Management Committee. The Management Committee is interested in if and how WLE adds value to the work of Centers in Ethiopia through Window 1 and Window 2 funding. The Management Committee hopes to use the evaluation findings to help ensure better approaches to programmatic research after 2022 when WLE, and other second phase CRPs (CGIAR Research Programs), will finish.

The secondary intended users are other stakeholders in WLE, including WLE investors, partners and the CGIAR System Organization.

Focus and objective of the evaluation

The focus of the evaluation is to help intended users understand how WLE has contributed to sets of outcomes identified by the WLE leadership and staff working in Ethiopia.

The objectives of the evaluation are:

4. To determine how and in what ways WLE contributed to the achievement of intended/unintended outcomes;
5. Based on the findings of the evaluation, make recommendations of how WLE (and its partners) can become more effective in supporting soil and water management in Ethiopia;
6. To serve as a participatory learning experience for WLE and its partners.

[7] https://wle.cgiar.org/about

Secondary objectives are to:

1. Make the case that investment in WLE research contributes to beneficial outcomes (without attempting to quantify the return on that investment);
2. Contribute to CRP reporting of Outcome-Impact Case Reports (OICRs).

2. Background and context of WLE

History of programmatic research in the CGIAR

The CGIAR (formerly the Consultative Group for International Agricultural Research) is a global partnership of 15 agricultural research centers distributed worldwide, mainly in the Global South. The CGIAR's vision is to "Reduce poverty and hunger, improve human health and nutrition, and enhance ecosystem resilience through high quality international agricultural research, partnership and leadership."

The CGIAR enjoyed early success in the 1970s breeding modern crop varieties that helped bring about the Green Revolution credited with increases in rice, wheat and maize yields that kept up with population increase, avoiding a Malthusian disaster predicted at the time. Success resulted in the CGIAR increasing in size from four to 13 centers by 1983. The new centers increased the crops the CGIAR worked on, and broadened research to include livestock, farming systems, conservation of genetic resources, plant nutrition, water management and policy research.

As the CGIAR continued to expand to 18 centers, pressure began to mount from donors for centers to become better at working together and to embrace more integrated, multi-disciplinary research approaches. This led to the launch of an ecoregional approach to research by the CGIAR in 1993 and then to the establishment of the Ecoregional Programme for the Humid and Sub-humid Tropics of sub-Saharan Africa (EPHTA). EPHTA lasted until 2002 when it was closed, largely because it had spent too long on characterization of the benchmark areas where it was going to work, rather than engaging on the ground.[8]

The ecoregional approach evolved into so-called system-wide programs. A meta review of systemwide and ecoregional programs identified 17, including the African Highland Initiative and the Global Mountain Program.[9] In parallel, the CGIAR launched the System-Wide Programs.

In 2001, the CGIAR embarked on a program of reform. Key among the changes implemented was the adoption of Challenge Programs as a means of harnessing the diverse strengths of CGIAR Centers. Three Challenge Programs were launched including the Challenge Program on Water and Food

[8] Douthwaite, B., Baker, D., Weise, S., Gockowski, J., Manyong, V.M. and Keatinge, J.D.H., 2005. Ecoregional research in Africa: learning lessons from IITA's benchmark area approach. *Experimental agriculture*, *41*(3), pp.271-298.

[9] Meta-Review of CGIAR Systemwide and Ecoregional Programs: Main Report https://cgspace.cgiar.org/handle/10947/4203

(CPWF). The CPWF ran from 2005 to 2013. A meta-review[10] lamented that the system-wide and ecoregional programs had very little influence on the Challenge Programs.

In 2008, the CGIAR embarked on another change process to improve engagement between stakeholders, not least between CGIAR Centers. The foundational idea was that all CGIAR research should take place within CGIAR Research Programs (CRPs) set up to tackle major global challenges, an approach not dissimilar to that taken by the already-existing Challenge Programs. This reform went deeper than previous change processes through, changing the structure of the CGIAR system such that donor funding could be channelled directly to CRPs through a CGIAR trust fund. Four funding windows were established:

- Window 1 - contributions received from funders without restriction and allocated to CRPs by CGIAR System Council; the SC is responsible for allocating the funding
- Window 2 - funders choose to which CRP funds are allocated
- Window 3 - funders allocate funds to specific Centers
- Bilateral projects – funds allocated by donors to specific projects and other programs

In setting up the CRPs, the expectation, shared by funders, was that all donor funding would eventually be channelled through W1 and W2 once the CRPs established themselves and all CGIAR research fell within a CRP.

CGIAR funders eventually agreed to the establishment of 15 CRPs, which ran from 2012 to 2016, of which WLE was one. Second phase CRPs are set to run from 2017 to 2021. The problem was that donors lost confidence in CRPs as the main funding vehicles for research during Phase 1. WLE Phase 2 has been operating in a context of sharply reduced budgets. Donors lost confidence in CRPs as the main funding vehicles for research during Phase 1. From 2014 to 2017 funding for CRPs fell by nearly 60% from US$ 382 million to US$ 160 million. During the same period, funding to the CGIAR as a whole fell by 20%,[11] in part because of changing donor priorities, including the refugee crisis in Europe.

WLE

WLE submitted its second phase proposal in March 2016 as the CGIAR was in the midst of dealing with this swinging cut to funding. WLE requested a budget of US$ 355 million over six years, with just 20% requested from the CGIAR Fund through Windows 1 and 2 and the remainder from the funding of bilateral projects 'mapped onto' WLE. A 'mapped' project is one that is deemed to contribute to the CRP results framework. In practice, CRP management committees have less say in how well bilateral projects fit within their strategy and results frameworks compared to the sub-grants they manage made with Window 1 & 2 funding. In its second phase, WLE had to accept a large tail (US$ 289 million bilateral funding) wagging a small dog (US$ 68 million Window 1 & 2 funding).

[10] Ibid

[11] https://cgspace.cgiar.org/bitstream/handle/10568/97418/2017-CGIAR-Financial-Report-Web.pdf p.16

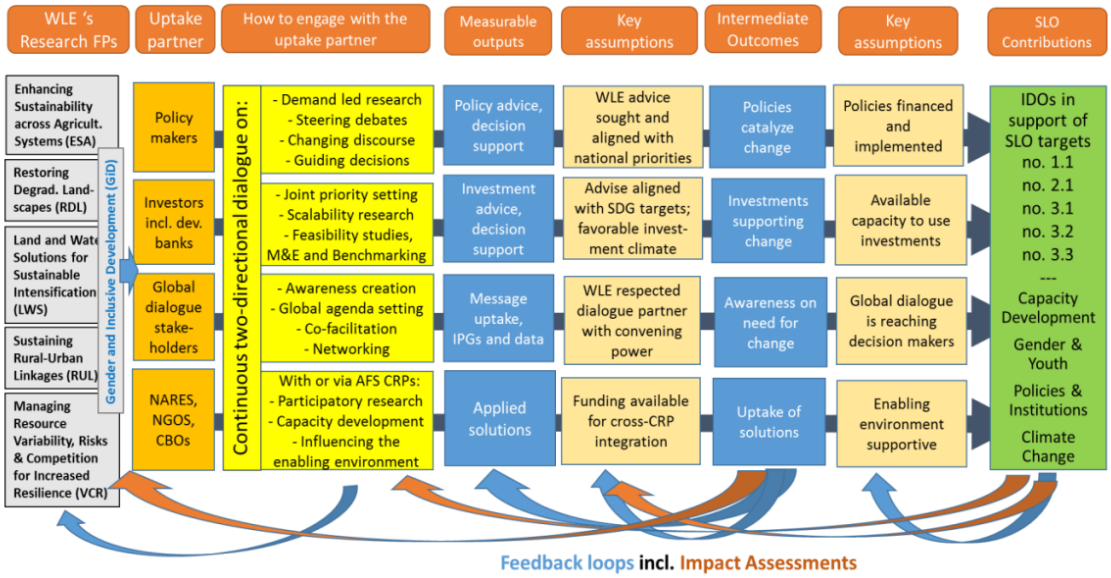
The WLE proposal, along with all the other CRP proposals, was structured around Flagship Projects. Flagship Projects were reviewed on their own merits and could be denied Window 1 funding completely or be allocated a smaller budget than requested. In practice, this led to Flagships being designed with sufficient independence that if one or more were rejected, the CRP as a whole would remain viable. The downside was that opportunities for profound complementarity were probably missed.

WLE proposed five Flagship Projects for phase 2 (2017-2021) together with a Gender Core Theme:

6. Restoring Degraded Landscapes
7. Land and Water Solutions for Sustainable Intensification
8. Sustaining Rural-Urban Linkages
9. Managing Resource Variability Risks and Competing Uses for Increased Resilience
10. Enhancing Sustainability across Agricultural Systems.

All five Flagship Projects were eventually funded.

Figure 1: WLE Impact Pathways and Theory of Change



WLE Phase 2 prioritized efforts in CGIAR target countries within the program's focal regions (Greater Mekong sub-region, the Ganges, East and West Africa) – Burkina Faso, Ghana, Nigeria, Ethiopia, Uganda, Tanzania, Bangladesh, India, Nepal, and Vietnam.[12] WLE contributes to an overall CGIAR Results and Strategy Framework by tackling five of the CGIAR's 'Grand Challenges':

1. Natural resources and ecosystem services
2. Climate-smart agriculture
3. Agricultural systems
4. Gender and inclusive growth

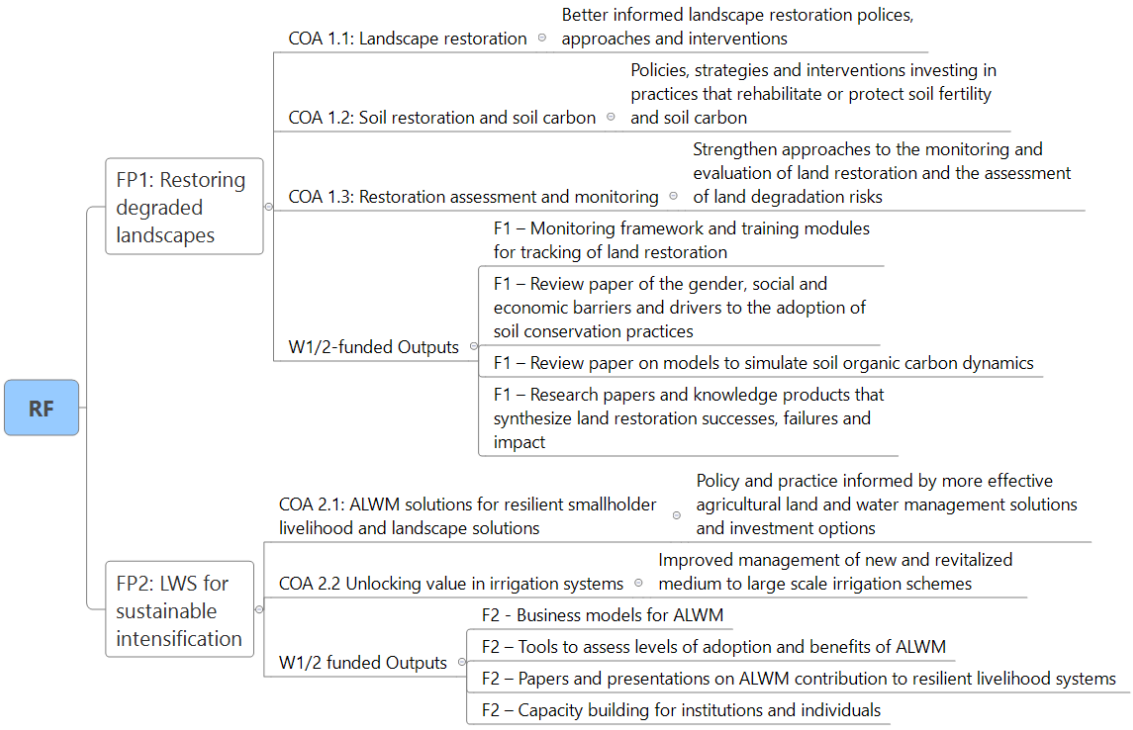
[12] WLE Phase 2 Annexes p. 208

5. Enabling policies and institutions

As the WLE theory of change shows, WLE's vehicles for planning and carrying out research for development are its Flagship Projects that may work on more than one Grand Challenge, and that do not necessarily have a geographic focus. While working in target countries, WLE does not nominate country-level coordinators nor expect countries to have a coherent program of work aimed at country-defined priorities. Such integration is expected to happen at the level of all CRPs working in a country.

WLE work in Ethiopia has taken place largely through two Flagship Projects (FPs) shown in Figure 22. Flagship Projects are organized around clusters of activities (COAs). The evaluation limited its scope to these.

Figure 2: Results framework for FP1 & FP2



3. Methodology

This evaluation used a version of outcome harvesting called outcome evidencing (Paz-Ybarnegaray & Douthwaite, 2017), the steps of which are shown in Figure 3. The evaluation TOR suggested the use of outcome harvesting, which is an evaluation approach that collects evidence of what has changed and, then, working backwards, determines whether and how an intervention contributed to

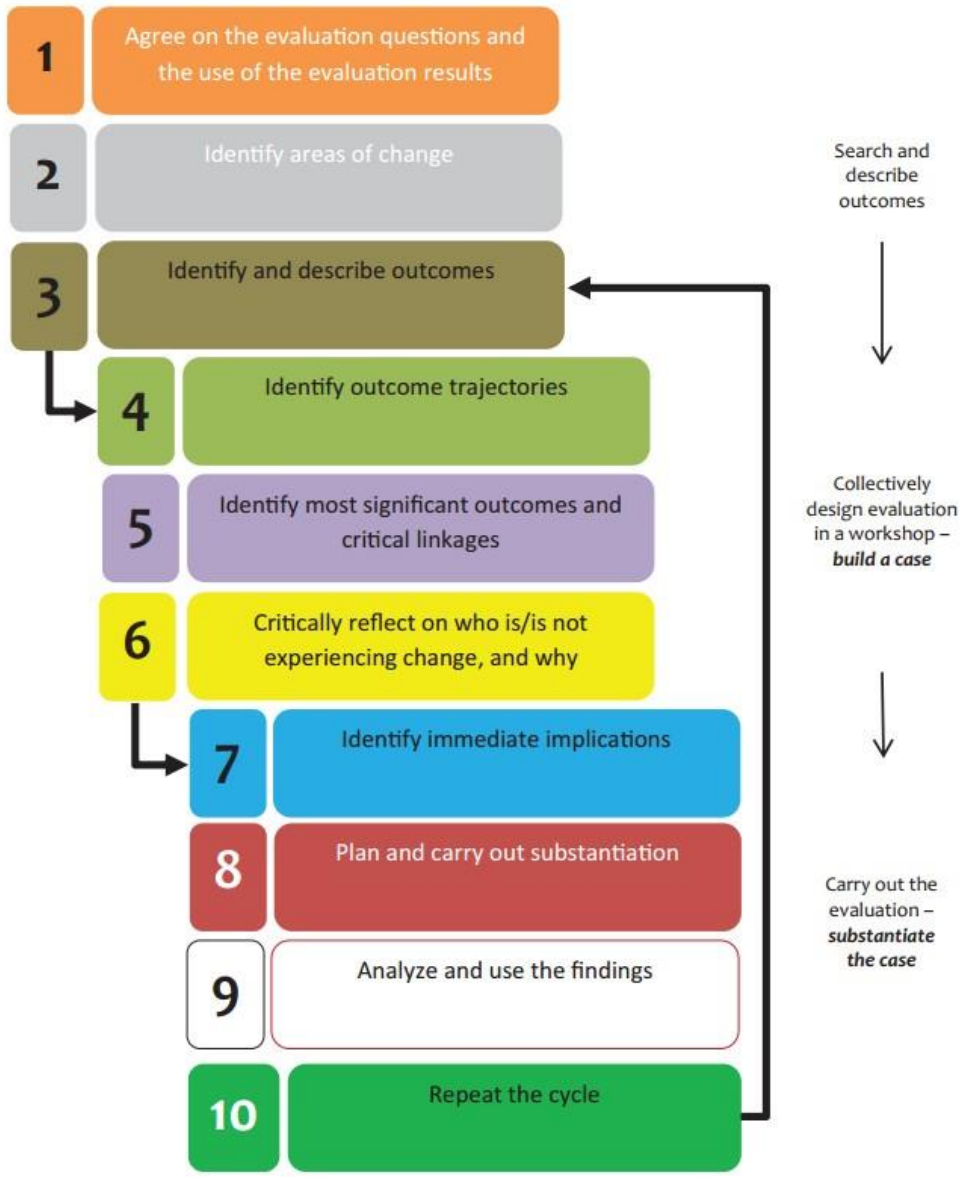
these changes. Outcome harvesting is commonly used in complex programs, such as WLE, where relationships between cause and effect are not well understood.[13]

Outcome evidencing was developed for use in a program[14] similar to WLE in research focus, working across scales and complexity of institutional and partnering arrangements. Outcome evidencing puts more emphasis than outcome harvesting on building causal models (i.e. ex-post theories of change) to explain *patterns* of outcomes resulting from program intervention. Outcome evidencing looks for inter-relationships and synergies between program activities and outcomes and is well suited to programs that want to optimize these as a strategy for achieving impact at scale.

[13] https://www.betterevaluation.org/en/plan/approach/outcome_harvesting

[14] CGIAR Research Program on Aquatic Agricultural Systems

Figure 3: Steps in Outcome Evidencing



Step 1: Agree evaluation questions

The evaluation team (the authors) completed Step 1 in an inception phase by agreeing to the evaluation questions to be addressed based on those provided in the TOR. After consulting with the WLE leadership a sub-question was added to focus on whether WLE generated synergies or cross-fertilization through its actions. Other minor changes were made during the analysis stage, such as the decision to have a main evaluation question on gender and to address questions on lessons learned in the conclusion. The evaluation questions and sub questions addressed by the evaluation are as follows:

4. What were WLE outcomes in Ethiopia and how did WLE contribute to them?
   4.1. What are the main outcomes to which WLE has contributed in Ethiopia?
   4.2. Were there any negative outcomes?
   4.3. Were there any unexpected outcomes?
   4.4. How did WLE contribute to outcomes?
   4.5. Were the Center/WLE contributions necessary and sufficient?
5. Did WLE help influence/contribute to the design and promotion of research that integrates/considers gender or the needs of marginalized groups within its partner centers?
6. Are WLE outcomes likely to be sustainable over the long term?
   6.1. How enduring are the outcome trajectories likely to be?
   6.2. Did WLE work with appropriate partners to achieve outcomes?
   6.3. How did WLE work with partners to contribute to outcomes?
   6.4. How and in what ways did WLE support influence decision-making processes within core partners and in specific geographical contexts?

Steps 2 to 4: Identify outcome trajectories and areas of change

The evaluation team (ET) also completed Steps 2 to 4 during the inception phase. The team met virtually with key staff working for WLE Flagship 1: Restoring Degraded Landscapes (RDL) and Flagship 2: Land and Water Solutions for Sustainable Intensification, who have led and carried out most of the WLE work in Ethiopia. In the meetings, the ET asked for nominations of key outcomes while at the same time reviewing program documentation, in particular, nominations for Outcome Impact Case Reports (OIRCs).

On this basis, the team generated a list of nine outcome trajectories (OTs) which was presented by the evaluation manager to the WLE Management Committee meeting in London in June 2019.

Although WLE documentation (e.g. OICRs) describe them as outcomes, according to outcome evidencing, it is more correct to refer to them as outcome trajectories (OTs) because they refer to a number of linked outcomes for different stakeholders that unfold over time and have some sort of direction: they do not refer to a single 'outcome.'

Based on the list, the ET proposed three areas of change (Step 2). An area of change is a set of outcome trajectories that share a characteristic by which they can become more than the sum of their parts. Putting it another way, the outcome trajectories in an area of change share a common causal mechanism.[15]

Steps 5 to 7: Outcome Evidencing Workshop

Step 5 was carried out during the outcome evidencing workshop held on 6 September 2019 in Addis Ababa. Two people were invited to work on each of the outcome trajectories, selected on the advice of the lead researchers from the four CGIAR Centers leading work on the respective OTs. The main selection criterion was that participants should play a leadership role within an OT.

Two additional OTs were suggested by lead WLE researchers during final preparation, and incorporated, bringing the number of OTs up to eleven (see **Error! Reference source not found.**). S

[15] Glossary of Terms for a definition of causal mechanism

eventeen participants attended together with the facilitation team (see Appendix 2 for the participants' list).

After introductions, participants developed timelines of the OTs to which they were assigned.

The ET asked participants to use an analogy – to think of the eleven OTs as eleven 'crimes' and that they were trying to build a case to 'convict' WLE of being involved. They were encouraged to think of the ET as the investigating team that would start their inquiries with the timelines.

Each timeline was presented to plenary and a recording made to allow details to be checked afterwards. There was also a plenary discussion in which others could add to or correct what had been said. In this way, presenting to plenary provided a form of fact-checking. Participants provided names of people who could verify their respective stories.

There was time for participants to reflect on what worked well and not so well with respect to WLE's contribution to the OTs. The evaluation manager sent around an on-line survey to allow participants to evaluate the workshop, in particular, if they had found it useful for them.

Steps 6 and 7 in Figure 3 were carried out after the workshop by the ET.

Step 8: Plan and carry out substantiation

After the workshop, on the advice of the four Center lead researchers, the ET visited Dessie and Hossana to see first-hand work being done on Area of Change 1 and 3, by three of the four Centers. Interviews in Addis focused on Area of Change 2 and gender.

Based on the timelines, audio recordings, interviews and review of supporting material (much use made of WLE communication material), each of the OTs was written up as a historical narrative beginning with the outcome claim being made, describing the historical role of the CGIAR Center/WLE in the outcome trajectory (OT) before reaching an evaluative judgement as to the strength and legitimacy of the causal claim. The descriptions of the OTs are provided in Appendix 2.

Step 9: Analyse and use the findings

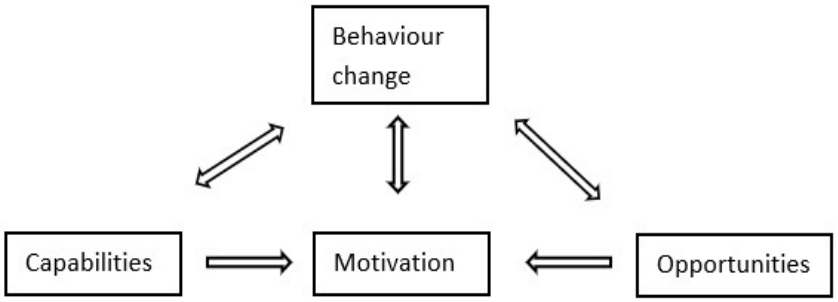
The discipline of writing out the histories of the OTs and the role of WLE/Centers in each is a form of analysis that helps to establish causality by establishing the time order of events and the causal links between them. The ET sent the histories to the respective workshop participants who had developed and presented the timelines for fact-checking. This allowed the ET to develop a better insight into the underlying mechanisms driving the OTs in each of the areas of change.

The ET used the insight to build a theory of change for each area of change. The OT histories, and the theories of change were used by the ET to answer the evaluation questions. The OT histories and the theories of change are presented in Appendix 1.

The theories of change are based on a behaviour change model developed, called the COM-B system model,[16] recommended by John Mayne,[17] known for having developed Contribution Analysis.[18]

The model says that behaviour change (B) occurs as a result of interaction between three conditions: capabilities (C); opportunities (O); and, motivation (M). The figure shows that both opportunities and capabilities can influence motivation and all three can influence, and be influenced by behaviour change.

Figure 4: The COM-B System Model



The ET produced a stand-alone executive summary to serve as a policy brief on the evaluation's key findings, conclusions and recommendations. The team also helped promote the findings through social media, e.g., through a blog post to help ensure the use of findings.

The WLE evaluation manager attended the workshop to audit the approach used for possible future use as a reflection and sharing tool in WLE.

[16] Michie, S., Van Stralen, M. M., & West, R. (2011). The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation Science*, *6*(1), 42.
[17] Mayne J. The COM-B Theory of Change Model. Working Paper, www.researchgate.net/publication/323868561_The_COMB_ToC_Model 4 (accessed 11 December 2018); 2018.
[18] Contribution Analysis explores attribution through assessing the contribution a programme is making to observed results. It sets out to verify the theory of change behind a programme and, at the same time, takes into consideration other influencing factors.

Table 1: WLE outcome trajectories grouped by area of change

Areas of change and outcome trajectories	Lead Center
Area of Change 1: Through demonstrating landscape approaches	
1A. Farmers benefiting from the development of multifunctional and resilient landscapes	CIAT
1B. Farmers improving their soils and water supply in the Yewol Mountains	ICRISAT
1C. Dryland pastoralists engaging in agriculture by harnessing floodwaters	ICRISAT
Area of Change 2: Through use of geospatial data	
2A. Soil-plant spectral technology guiding soil fertility investments in Ethiopia	ICRAF
2B. Ethiopia adopts a new soil strategy to target soil fertility management interventions in various landscape niches	ICRISAT
2C. Contribution to the Ministry of Agriculture approving a soil and agronomy data sharing policy key to agricultural transformation in Ethiopia	CIAT
2D. Ministry of Agriculture makes an inventory of the area under irrigation in Ethiopia	IWMI
Area of Change 3: Through transformative use of technology	
3A. WLE contribution to the Prime Minister of Ethiopia approving a policy to make all agricultural water technologies exempt from taxation	IWMI
3B. Pilot schemes of climate-smart water lifting technology led to large-scale public investments in solar-powered irrigation practices	IWMI
3C. Harnessing Ethiopian floodwaters at landscape level helps dryland pastoralists	ICRISAT
3D. Ecological footprint of food security: mapping irrigated area in Ethiopia	IWMI

The main limitation of the evaluation is the sensitivity of identifying people in the descriptions of the OTs. Change involves people and their motivations. Being circumspect about who did what and why

makes it harder to understand the underlying mechanisms that drive change. The approach the ET took is to anonymize responses by assigning each respondent with a reference number. Names are used when the information is already publicly available, for example when a scientist is quoted and named as part of blog post. Job positions are given when doing so, strengthens the point being made, and the point is not judged likely to be controversial by the ET.

4. Findings

EQ1: What were WLE outcomes in Ethiopia and how did WLE contribute to them?

EQ 1.1 What are the main outcomes to which WLE has contributed in Ethiopia?

Finding 1: WLE has contributed to ten outcome trajectories (OTs) that fall into three clusters, called 'Areas of Change' (AoC) defined by the underlying causal mechanisms that are driving them (see Table 1). The OTs can also be characterized by:

- **All taking longer than a single CRP funding cycle, and some with roots going back more than ten years**
- **Achieving on-the-ground impact in the order of low thousands of households reached, orders of magnitude less than the ambition indicated in the WLE Phase 2 proposal (a million households in Ethiopia)**

Several OTs have the potential to achieve the scale of impact promised by WLE, but over a longer timeframe.

Participants at the outcome evidencing workshop reflected that constructing timelines to describe the OTs helped them appreciate the substantial amount of work being carried out and the large potential for collaboration that exists. It helped them go beyond a project focus to see the 'big picture' and several said they wished to repeat the exercise for this reason.

The main OTs that WLE contributed to were identified during the inception phase of the evaluation as described in the Methodology section above. The final list is shown in Table 2.

The OTs are grouped according to the underlying mechanism driving them. The ET identified three mechanisms corresponding to three 'areas of change' (AoC):

1. Through development and demonstration of an approach to improve a landscape/watershed so that farmers, NGOs, the government and donors adopt and scale the approach
2. Through more and better use of geospatial data to transform decision-making in agriculture
3. Through research on and promotion of potentially transformative technology, including removing barriers to adoption.

The mechanisms were clarified through writing out, validating and analyzing histories of each OT, starting with a workshop where the main 'champions' for each OT constructed timelines for their respective OTs. The ET used the timelines to write out narrative descriptions of the OTs, each OT presented in Appendix 1. This process helped the team clarify the underlying mechanisms/AoCs. The titles of the AoCs, and the allocation of OTs to them changed somewhat during and after the workshop. Two OTs were combined.

Workshop participants found it useful to develop and share the timelines. One participant said that the workshop had helped them appreciate the substantial amount of work going on and the large

potential that exists for collaboration. Other participants said they wanted to repeat the exercise for this reason.[19]

In addition to underlying causal mechanisms, the WLE OTs can also be characterized by timeframe, the scale of impact and impact potential.

Table 2 shows that six of the ten OTs began in 2014 and three in 2011. All but one OT began in Phase 1 of WLE, or before. Most built on previous work, for example, the OTs under AoC-1 all draw from the development of a landscape approach in the Nile Basin Program of the Challenge Program on Water and Food.[20]

Despite spanning more than the five-year CRP cycle, none of the OTs had yet come close to contributing to impact at the scale envisioned in the WLE Phase 2 proposal (i.e., one million farm households adopting new technologies and/or improved practices in Ethiopia by 2022). The AoC-1 work on landscapes is presently directly affecting adoption decisions of somewhere in the order of a thousand households.

While current impact levels may be low, most of the OTs have a large impact potential. OT-1A is being carried out under the auspices of Africa RISING (Africa Research in Sustainable Intensification for Next Generation) with a target to reach three-quarters of a million households in Ethiopia by 2022. OT-1C is part of a larger effort that is promoting the use of water-spreading weirs over 3.5 million hectares. AoC-2 on big data is part of a broader attempt to provide farmers and government with site-specific soil fertility and agronomy recommendations, maps and databases that those involved believe could save Ethiopia billions of dollars.[21] AoC-3 is helping create a more enabling environment for low-cost solar pumps that have the potential to allow for dry season cropping over an area of at least 1.1 million hectares.[22]

EQ 1.2. Were there any negative outcomes?

Finding 2: There are risks of negative outcomes if promising solutions are scaled too quickly, or through a top-down process. There is some evidence of this happening in AoC-2 with respect to fertilizer recommendations. In AoC-1, of particular concern is the premature promotion of water-spreading weir technology that is possible through a new World Bank project. On the other hand, there are also risks of being over-cautious.

History shows that promising new technologies may be scaled too early and too broadly by government programs. There is some evidence that this has and could apply to some of the WLE OTs. For example, in AoC-2, starting in 2017, fertilizers were blended and distributed according to nutrient deficiencies identified by an EthioSIS (Ethiopian Soil Information System) soil survey and soil

[19] Based on responses to a workshop evaluation, see here
[20] Merrey, D. and Clayton, T. 2013. A new integrated watershed rainwater management paradigm for Ethiopia: Key messages from the Nile Basin Development Challenge. NBDC Brief 14. Nairobi, Kenya: ILRI.
[21] 39
[22] http://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/pub172/rr172.pdf

property maps. This was a case of the wrong use of information supplied by the soil maps which were meant to guide to what nutrients to test in crop response trails, before recommending what blends to use. Although more expensive, farmers apparently found no overall yield increase, and have been complaining and refusing to use the blends. The issue has been discussed in parliament.[23]

A concern has been raised by a knowledgeable source in Gesellschaft fur Internationale Zusammenarbeit (GIZ) that more research is required on the technical and social performance of water-spreading weirs in Afar, before the technology is more widely promoted.[24] This is because the technology is relatively young and unproven in East Africa, and is being introduced into agro-pastoral systems where such agricultural practices may be new and contested, e.g., fencing of land to protect crops from animals.

A large US$ 456 million World Bank project was due to start in 2019 to improve livelihood resilience of pastoral and agro-pastoral communities in Ethiopia. The project document prioritises the elements of the Afar Soil Rehabilitation project as the way forward for agro-pastoralists and says that the project's approach merits scaling up.[25] Hence, there is a risk that water-spreading weirs will be promoted too early and too widely. On the other hand, this is also an important scaling opportunity that ICRISAT/WLE (International Crops Research Institute for the Semi-Arid Tropics/WLE) contributed to by being asked to review and comment on the proposal. There is also a risk of being over-cautious and missing an opportunity to bring beneficial change to 3.5 million hectares.

EQ 1.3 Were there any unexpected outcomes?

Finding 3: There were a number of unexpected positive outcomes, resulting from Centers/WLE being well-positioned to catalyze and support the actions of partners. WLE's strength is in providing flexible outcomes to pursue opportunities, but not always. Lack of funding prevented one opportunity being taken up – to develop guidelines for the Ministry of Finance to ensure small-area farmers benefit from tax exemption on agricultural equipment.

WLE has enabled a common way of working that makes such opportunities, and responding to them, more likely.

The innovation literature suggests that outcomes are often unexpected because they emerge as a result of interactions between actors that are hard or impossible to predict.[26] Responding to unexpected opportunities to contribute to OTs is acknowledged as an effective scaling strategy. The OTs provide some examples:

[23] Respondent 39
[24] Respondent 38
[25] http://documents.worldbank.org/curated/en/849011553174003078/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Lowlands-Livelihood-Resilience-Project-P164336.pdf
[26] Axelrod, R. M., & Cohen, M. D. (2000). *Harnessing complexity*. Basic Books.

- ATA picking up the idea – coming from IWMI-led research – of tax exemption for water pumps and pursuing it such that the Ministry of Finance has agreed to a tax exemption for all agricultural equipment, still to be implemented (OT-3A).
- ATA then asking IWMI/WLE to develop implementation guidelines to ensure smallholders capture some of the benefits. Well-constructed guidelines could have important positive outcomes for smallholders. However, this opportunity was unfortunately missed because of lack of funding to do the work (OT-3A).
- The three OTs on soil mapping and fertilizer recommendations in AoC-2 are contributing to a broader causal package[27] required for Ethiopia to develop and maintain a soil fertility and agronomy information system that will provide farmers with accurate site-specific recommendations (OT 1.2, 2.2 & 2.3).
- Presentation of IWMI/WLE's mapping of irrigated areas leading to an inventory being carried out by the regions, leading to a halving of the official estimate. Opportunities may arise from this, for which IWMI/WLE is well placed to respond. In doing the work, the Ministry of Agriculture signalled an unexpected institutional change that regions should report reliable data, and not be held to old estimates that may have had errors in their computation (OT-2.4).
- Participants in the Outcome Evidencing workshop identified a common, emergent way of working that makes such opportunities, and responding to them, more likely. They called the way of working 'impact tracking,' see Finding 5.

[27] That is the research outputs and processes together with other inputs and conditions necessary for the change to happen and be maintained.

Table 2: Plausible causal claims for ten WLE outcome trajectories and the contribution of WLE

Headline claim	Plausible causal claim	Contribution of WLE	Start date
1A. Farmers benefiting from the development of multifunctional and resilient landscapes	CIAT/WLE has contributed to more multifunctional and resilient landscapes in 6 to 8 learning sites. The target of improving livelihoods of 2000 households is not yet demonstrated, but plausible through the incorporation of work in a large project (Africa RISING).	- Catalytic: Belief that without WLE funding, landscape work in Africa RISING would not have happened - Funding for CIAT (International Center for Tropical Agriculture) staff salaries	2014
1B. Farmers improving their soil and water supply in the Yewol mountains	ICRISAT/WLE has improved the soils and water supply in a micro watershed in the Yewol Mountains, working in a kebele of 884 households. Anecdotal evidence exists that aspects of the approach are spreading.	- Catalytic: Belief that without WLE support the work would not have restarted - Funding provided to Wollo University	2011
1C. Dryland pastoralists engaging in agriculture by harnessing floodwaters	ICRISAT/WLE, with partners, has developed and demonstrated agricultural practices on 46 ha of newly cultivatable land adjacent to water-spreading weirs, benefiting 52 households.[28] GIZ had the idea to transfer the weirs from West Africa and paid to build them. ICRISAT/WLE has actively promoted the technology saying it could bring benefits to 3.5 million ha in Afar, Somalia region and the Omo-Gibe basin. There is evidence of some response from government and investors: the Ethiopian Bureau of Pastoral Agriculture and Development is expected to scale the technology to multiple communities. A recently-started US$ 465 million World Bank project is likely to scale the technology in Ethiopia.	- Funding for ICRISAT staff salaries	2014
2A. Soil-plant spectral technology guiding soil fertility investments in Ethiopia	ICRAF/WLE has made an important contribution to the development of EthioSIS, and the soil maps EthioSIS has produced. ICRAF/WLE is contributing to a yet-to-be-developed soil and agronomy information system that can provide accurate site-	- WLE funding has allowed ICRAF's Soil-Plant Spectral Diagnostics Lab to do more than it otherwise could to advance technology and	2011

[28] https://www.icrisat.org/case-of-the-afar-region-in-ethiopia-the-lone-green-patch-on-a-denuded-stretch/

	specific recommendations. Current recommendations are not yet leading to uniformly higher production, but that is the goal.	support capacity development efforts, through supporting salaries, capacity development and equipment purchases.	
2B. Ethiopia adopts a new soil strategy to target soil fertility management interventions in various landscape niches	ICRISAT/WLE has developed the first version of a decision guide providing crop- and soil-specific nutrient advice in landscapes. A second version is being developed. The work has informed part of a national research strategy on soil fertility and health adopted in 2017 that goes well beyond interventions in landscape niches and is yet to be fully implemented.	Funding for ICRISAT staff salaries	2014
2C. Contribution to the Ministry of Agriculture approving a soil and agronomy data sharing policy key to agricultural transformation in Ethiopia	CIAT/WLE has contributed to the development and agreement on a soil and agronomy data sharing policy due to be ratified in December 2019. CIAT/WLE has also contributed to data standardization and upgrading of databases. This, and the two proceeding OTs, are part of a larger 'big data' endeavor to enable farmers to receive better advice on agronomy and soil fertility, potentially saving Ethiopia billions of dollars in wasted fertilizer application and helping reduce soil depletion and acidification of millions of hectares of cropland. This endeavor is being coordinated in part by a GIZ project.	WLE funding has been used to support the time of staff working on data sharing policy.	2017
2D. Ministry of Agriculture recalculates the area under irrigation in Ethiopia	Presentation of IWMI/WLE research to the Minister of Agriculture led to the regions remapping irrigated areas. The new estimate of about 1 million hectares, less than half of the old one, is now used in official statistics. It is not yet clear what outcomes will result from this recalibration. IWMI/WLE also helped build the capacity of the government experts who carried out the remapping.	WLE funding supported all aspects of the work, including staff time and for training of federal and regional experts.	2014
3A. Contribution to the Prime Minister of Ethiopia approving a policy to make all agricultural equipment exempt from taxation	IWMI contributed catalytically to the Prime Minister of Ethiopia approving a policy to make all agricultural equipment exempt from taxation. ATA (Ethiopian Agricultural Transformation Agency) acted on a recommendation from an IWMI-led AgWater project in 2011 (before WLE) to remove tax from water pumps. This led to the approval of tax exemption for all agricultural	WLE support was limited to supporting some IWMI staff time to accompany the ATA work.	2011

	equipment by the Ministry of Finance in May 2019. IWMI/WLE was asked to put together implementation guidelines by the government but had to decline because of lack of funding.		
3B. Large-scale piloting of solar pumps by ATA	IWMI/WLE contributed catalytically to the decision for ATA to pilot 160 solar pumps and creating a more enabling environment for the technology through the government's decision to remove import tax on agricultural equipment.	Funding for IWMI staff, for the preparation of solar pumping business models and in carrying out a baseline survey	2014
3C. Exclosures increasingly used as a source of sustainable economic benefit by women, youth and landless	Two consecutive WLE-funded projects contributed to the greater sustainable use of exclosures in six watersheds, to the benefit of the communities upon whose land they are situated. While the work did not initiate the idea of using exclosures for economic benefit, it has helped provide a catalogue of suitable income-generating activities and business models. The project placed emphasis on bringing benefits to women, youth and the landless.	This work was 100% funded by WLE.	2014

EQ1.4 How did WLE contribute to outcomes?

Finding 4: WLE contributed to the outcome trajectories by working through four CGIAR Centers (CIAT, ICRAF, ICRISAT, and IWMI). Outputs from two WLE Flagship Projects made a contribution to OTs, such as: ALWM business models; synthesis of land restoration successes and failures; and, capacity building. WLE's contribution was unclear to most national partners. Two exceptions were for work largely funded by WLE (OT 2.4 & 3.3).

WLE contributed to the OTs by working through its lead center – IWMI – and three Tier 1 partners – ICRISAT, CIAT and ICRAF. In eight out of ten of the OTs, the four CGIAR centers had more recognition from collaborators than did WLE. Indeed, some field staff and collaborators, including a small number who worked on the timelines for the OTs, did not know their work was connected to WLE until invited to the workshop. In recognition of this, the ET was asked to begin the workshop with a description of WLE. The invisibility of WLE was not helped by center publicity which often did not mention the contribution of WLE in blogs or on-line articles.[29] This was balanced to a certain extent by WLE publicity republishing such articles on its own website.[30]

The two exceptions where WLE is visible are with exclosure work (OT 3.3) and irrigation mapping (OT 2.4). With the former, WLE funded the initial work and then funded a larger project, through a regional call for proposals, led by a national research institute (ARARI). The latter was also largely funded by WLE, led by IWMI.

The ET found little mention of the Flagship Projects in explanations of how a Center/WLE had contributed to the OTs. However, flagship products such as business models, maps and synthesis of approaches to landscape restoration, were important parts of OT causal packages as described in Appendix 2.

The flagship products appear to be working to a greater or lesser extent as 'boundary objects.'[31] Boundary objects allow researchers to work with other stakeholders to seek solutions across the research-policy divide. They are most effective when they are themselves co-developed, and when they are based on high quality research. The business models developed in the exclosures and solar pumping OTs appear to be working by making explicit to policy makers the pathways they can take to achieve beneficial outcomes, e.g., the sustainable pro-marginalized-group use of exclosures and greater use of solar pumps to increase agricultural production and reduce the use of fossil fuel. Helping show policy makers plausible ways of reaching policy goals makes positive change more likely.

Finding 5: WLE's relatively small amounts of W1/W2 funding has been used to support staff salaries, develop research outputs and carry out capacity development. At a deeper level, Center/WLE leadership in Ethiopia recognize that the flexibility this funding provides has allowed for the emergence of a common way of working called 'impact

[29] For example, http://www.icrisat.org/impacts/impact-stories/Icrisat-impacts-67.htm
[30] For example, https://wle.cgiar.org/all-us-yewol-mountains
[31] See https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2663982/ for more on boundary objects

tracking.' Impact tracking has supported, and at times been catalytic, in the success of an impressive set of outcome trajectories.

Table 2 shows the contributions made by WLE for each OT. For eight OTs, the WLE contribution was providing salary payments to CGIAR researchers and to a lesser extent funding partner involvement, capacity development and equipment purchases. Presumably, salary funding was provided to staff to deliver on agreed W1/W2 funded outputs for two Flagship Projects (see Figure 2).

Workshop participants were asked to reflect on what had worked well with respect to the WLE contribution to the OTs. The reply given was that WLE had made possible a common way of working in Ethiopia – impact tracking – described as:

- Allowing work to continue despite funding cuts, making possible continued support to the OTs
- Allowing for demand-driven work in line with government priorities, in which government partners are involved from the outset
- Based on local networking, allowing for Ethiopian 'insiders' to make things happen
- Being able to respond to a dynamic and changing funding environment
- Maintaining conceptual continuity over time, e.g. on taking a landscape approach
- Providing links to international universities

Finding 6: Despite the existence of WLE, the Ethiopian leadership of the four core CGIAR Centers say that they find themselves competing for the same funds while wishing it otherwise. Competition is leading to lost synergies and lost funding. Past experience suggests better collaboration requires ample and secure funding, a common goal and a more realistic understanding of the time it takes to achieve outcomes.

Participants were also asked about how WLE could make a greater contribution. A spokesperson said that WLE could improve by adopting a more realistic view of how long it takes to achieve outcomes, the level of investment required and acknowledgement that outcomes can be unexpected and depend on the ability to pivot when opportunities to contribute arise.

There was general agreement in the group that low and inconsistent funding was a deterrent to CGIAR Centers working together under WLE. CIAT, ICRISAT, ICRAF and IWMI scientists agreed that while they wanted to work together, they were in reality competitors for the same funding opportunities. They said that the situation had been much better under the CPWF when there had been more funding and a geographic focus to the work.[32]

Three examples of unexploited synergies were given:

- That water-spreading weirs (OT-1C) will raise the local water table making solar pumps an option (OT-3B);
- That better upstream management of watersheds (OT-1A & 1B) will reduce the severity of downstream flooding and siltation, thus making water-spreading weirs more feasible (OT-1C); and

[32] The Nile Basin Development Challenge of the CPWF was to improve the resilience of rural livelihoods in the Ethiopian highlands through a landscape approach to rainwater management

- ICRISAT soil fertility trials (OT-2B) did not leverage soil spectral technology that ICRAF (International Centre for Research in Agroforestry) helped EthioSIS to set up (OT-2A).

The ET found some evidence that funding had been lost through competition between core CGIAR centers. A knowledgeable and independent source[33] said that USAID (United States Agency for International Development) was put off investing millions on soil fertility work as a result of public competition at the "Joint Summit on Soil Fertility to Scale" held on May 23-24 in Addis Ababa.

EQ1.5 Were the Center/WLE contributions necessary and sufficient?

Finding 7: Center/WLE contributions were a necessary but not sufficient part of the 'causal packages' that have maintained the momentum of the OTs. The OTs would likely not have developed without WLE contribution, or not proceeded as far. A crucial part of the WLE contribution was to allow OT champions to operate.

Conceiving of WLE outcomes as OTs and writing their histories helped identify the theory of change for each area of change, see Appendix 1. The theories of change show the 'causal packages' required for progress to be made along the trajectories. The causal packages include contributions from a number of actors. For example, the Yewol OT required inputs from ICRISAT, Wollo University, Sirinka Agricultural Research Center and the Bureau of Agriculture at various levels. The involvement of government was crucial for terrace construction in the micro watershed through mass mobilization and through food for work programs. Inputs included funding, facilitation, capacity development and technologies.

The descriptions of the OT causal claims (Table 2) show that Center/WLE contribution, while necessary and sometimes catalytic, never constituted the whole causal package and so was never sufficient.

What is remarkable is that the ten OTs have been able to maintain momentum over a number of years; in other words, they have maintained a necessary and sufficient causal package. Center/WLE interventions – in particular the championing of the OTs by lead Ethiopian researchers, working partly for WLE, has been a central and necessary part of the causal package. An OT champion is someone who sees value in the OT, promotes it and works to keep it going by bringing in the necessary resources to do so. An OT champion is similar to a 'product champion' in the business world – someone who sees value in technology, develops it, and entices decision-makers to invest, sell or promote the technology. Part of WLE's contribution to the OTs was to fund some of the OT champions' time and allow them to function as champions.

[33] Respondent 39

EQ 2: Did WLE help influence/contribute to the design and promotion of research that integrates/considers gender or the needs of marginalized groups within its partner centers?

Finding 8: WLE had the most influence on the gendered design of a project it funded through a regional call for proposals (OT 3.3).

The OT with the greatest emphasis on gender and inclusion is OT 3.3 on exclosures. The work was fully funded by WLE and designed in keeping with the WLE Gender Strategy.[34] From the start, work took into account that poor women, youth and the landless are disproportionately affected by exclosures that prevent them from using common land for collecting firewood and fattening sheep or goats. The project looked at how these and other income-generating activities can be reintroduced into exclosures in a sustainable manner, for the benefit of poor women, youth and the landless. Women and landless people were helped to purchase sheep to fatten with their quotas of forage cut and carried from the exclosures.

Finding 9: In several OTs, questions on gender inclusion are answered by saying that female-headed households are included in the selection of collaborating farmers without much consideration as to whether they can participate on an equal footing. Gender research suggests that they do not.

Phase 2 of Africa RISING put a significant emphasis on gender as a cross-cutting theme.[35] The program document said that "AR combines gender analysis of intra-household resource allocation with an analysis of the gendered effects of institutions."[36]

In terms of implementation on the ground, the ET found that the Africa RISING approach is to select lead farmers in open meetings based on interest and good performance. Africa RISING stipulated that a proportion of women-headed households should be selected. A lead farmer in Lemo District near Hossana said of 60 farmers chosen to participate, 6 were women, either widows or married women more interested and involved in farming than their husbands.[37]

Interviewees in Hossana said that women lead farmers were treated the same as their male counterparts. However, they also said that women found it harder to fully participate because they had other household responsibilities, and so perhaps should be treated differently.

This perception was supported in an interview with a social scientist who worked for WLE.[38] She was critical of the government extension system based on model farmers to provide an example to others. Model farmers tend to be better off and predominately male. She said that female-headed households, where the husband has died or left, subsequently lose labour, land and a voice in collective decision-making. She was also critical of projects that 'tick the gender box' by including

[34] http://www.iwmi.cgiar.org/Publications/wle/corporate/wle-gender-strategy.pdf
[35] AR_phase2_program_proposal.pdf available here
[36] Ibid p. 27
[37] Respondent 35
[38] Respondent 37

female-headed households without actively seeking to address this downward spiral. She also spoke of an "engineer" mindset that focuses on making infrastructure and technology work technically with little consideration of winners and losers.

Finding 10: Use of guidance on how to consider gender when promoting small-scale irrigation technologies in Ethiopia has been disappointing, in part because the dominant extension model is based on meeting installation quotas and judges success on technical function rather than on social inclusion.

A 2016 study[39] carried out by IWMI and IFPRI in Ethiopia, Ghana and Tanzania, linked to Africa RISING, looked at intra-household rights over irrigation technologies, including solar pumps. [40] One finding was that a focus on women in women-headed households misses out on women in male-headed households who may be farming their own land and cannot rely on access to technology through their husbands. Based on the results, the authors produced guidance on how to consider gender when promoting small-scale irrigation technologies.

One of the authors expressed disappointment that while the response to the guidance had been positive in Ghana and Tanzania, the same was not true for Ethiopia,[41] in part because the Ethiopian extension system focused on meeting quotas of installed irrigation technology more than concerns about social inclusion. The author doubted that an evaluation such as this one could hope to uncover the reasons and incentives for not using research-based evidence or tools in development projects in Ethiopia.[42] Whatever the underlying reasons, the ET found that despite the intention, and some good research, the implications of the intrahousehold research was having little obvious influence on the OTs working on irrigation (OT-1A, 1B & 3B).

EQ 3: Are WLE outcomes likely to be sustainable over the long term?

EQ 3.1: How enduring are the outcome trajectories likely to be?

Finding 11: The OTs have a history and momentum that suggests they can continue and scale into the future. Momentum comes from:

- **Being highly relevant to the development needs of Ethiopia**
- **Working closely with government partners**
- **The emerging "WLE" approach that includes "impact tracking" – where champions find ways to keep research and engagement in place, despite funding gaps**
- **Being driven by positive feedback loops**

[39] Theis, S., Lefore, N., Meinzen-Dick, R. and Bryan, E., 2018. What happens after technology adoption? Gendered aspects of small-scale irrigation technologies in Ethiopia, Ghana, and Tanzania. *Agriculture and human values*, *35*(3), pp.671-684.
[40] The work was mapped onto WLE, although WLE is not acknowledged in the publications coming out of the research.
[41] Respondent 44
[42] Ibid

Continued funding is required, in particular for Center/WLE champions, to look for opportunities where relatively small amounts of funding can have a large impact.

Center/WLE research has contributed to ten OTs that have already endured for an average of six years. Momentum has come in part from the OTs being highly relevant to the development needs of Ethiopia. For example, reversing land degradation has been the subject of billions of dollars of GoE and multilateral donor investment for decades (AoC-1). From 1976 to 1990, 2.6 million kilometers of bunds and terraces were built. In 2015, Ethiopia pledged to rehabilitate 15 million hectares of land by 2020.[43] Improving soil fertility and agronomy advice is a main GoE priority as part of increasing agricultural productivity (AoC-2). Solar pumps are seen as a promising way of improving agricultural productivity by allowing crops to be grown in the dry season (AoC-3).

Center/WLE research is likely to remain relevant because of the WLE approach in Ethiopia of impact tracking (see Finding 5). Impact tracking involves champions keeping the research going and continuing to engage partners going across funding gaps – together with working closely with government on government priorities.

Appendix 1 shows causal models of how the ET sees the OTs working within their respective AoCs. Each causal model has a self-reinforcing feedback loop where success breeds more success. All three causal models are based on the COM-B model (see Figure 4) in which behaviour change results from changes in capabilities, opportunities and motivation. The positive feedback loops involve:

- AoC-1 – Positive experience of soil and water-conserving infrastructure leading to benefitting communities taking ownership of the infrastructure and building more. This is accompanied by changes in by-laws necessary to ensure benefits happen, leading to broader compliance, more benefit and so on.
- AoC-2 – A community of researchers developing better ways of sharing, storing, accessing and analysing data, leading to the development of decision support tools, the successful use of which drives further funding and innovation.
- AoC-3 – Piloting potentially transformative technologies and improving the enabling environment for them leads to greater capabilities, opportunities and motivation to adopt and use them, leading to greater use, leading to greater capabilities, opportunities and motivation, and so on.

The positive feedback loops are necessary to keep OT momentum going, but are not sufficient. Some level of funding for fieldwork, capacity development and support to facilitation will also be necessary. For example, the soil spectral library created by EthioSIS needs US$ 500,000 for calibration before it can be used to its full potential.

The ET found evidence of positive feedback loops in conversations with farmers. In AoC-1, a woman farmer described how her view of the possibilities of dry season farming was transformed by an exchange visit to Tigray (OT-1A). She was able to adopt and adapt what she had seen with support

[43] Woldearegay, K., Tamene, L., Mekonnen, K., Kizito, F. and Bossio, D., 2018. Fostering food security and climate resilience through integrated landscape restoration practices and rainwater harvesting/management in arid and semi-arid areas of Ethiopia. In *Rainwater-Smart Agriculture in Arid and Semi-Arid Areas* (pp. 37-57). Springer, Cham.

from CIAT/WLE through Africa RISING. Farmers from her watershed, and others, now visit her farm to be inspired in turn.

Also in AoC-1, the Deputy Prime Minister and six ministers visited the Yewol micro-watershed (OT 1B) and in so doing provided positive reinforcement to all involved, including farmers, development agents, local government and Wollo University staff.

EQ 3.2: Did WLE work with appropriate partners to achieve outcomes?

Finding 12: The fact the OTs exist and endure suggests that Centers/WLE are working with appropriate partners. Centers/WLE are sharing the role of brokering appropriate partnerships with a range of other organizations and entities.

At one level, the fact that the OTs exit and endure suggests that the appropriate partners are involved. Table 3 lists the organizations brokering partnerships for each OT. It shows that the lead CGIAR partners/WLE are playing a joint or secondary role in deciding with whom to work. For all OTs, the decisions are being shared with a bilateral project (Africa RISING), an implementing agency (GIZ), government organizations (Ministry of Agriculture and ATA) and Ethiopian research organizations (ARARI and Wollo University).

Table 3: Who brokered the partnerships involved in the WLE outcome trajectories?

Outcome trajectories	Partnerships were brokered primarily by:
1A. Farmers benefiting from the development of multifunctional and resilient landscapes	Africa RISING project and CIAT
1B. Farmers improving their soil and water supply in the Yewol Mountains	ICRISAT and Wollo University
1C. Dryland pastoralists engaging in agriculture by harnessing floodwaters	Afar Soil Rehabilitation Project (GIZ) and ICRISAT
2A. Soil-plant spectral technology guiding soil fertility investments in Ethiopia	EthioSIS (part of ATA) and ICRAF
2B. Ethiopia adopts a new soil strategy to target soil fertility management interventions in various landscape niches	ICRISAT and Africa RISING
2C. Contribution to the Ministry of Agriculture approving a soil and agronomy data sharing policy key to agricultural transformation in Ethiopia	Supporting Soil Health Initiatives in Ethiopia Project[44] (GIZ) and CIAT
2D. Ministry of Agriculture recalculates the area under irrigation in Ethiopia	Ministry of Agriculture and IWMI
3A. Contribution to the Prime Minister of Ethiopia approving a policy to make all agricultural equipment exempt from taxation	ATA and IWMI
3B. Large-scale piloting of solar pumps by ATA	ATA and IWMI
3C. Exclosures increasingly used as a source of sustainable economic benefit by women, youth and the landless	ARARI and IWMI

The OT narratives show that the respective Center/WLEs worked with a range of partners including NGOs and the private sector.

[44] Part of Integrated Soil Fertility Management (ISFM+) project

EQ 3.3: How did WLE work with partners to contribute to outcomes?

Finding 13: The role of bringing WLE core partners to work together has been played by Africa RISING for AoC-1, GIZ for AoC-2 and ATA for AoC-3. It is positive that larger, better financed and more development-oriented initiatives are playing the integrating role ahead of WLE. Nevertheless, a role for WLE leadership remains to address the following:

- **Center/WLE lead researchers to recognize synergies that remain untapped**
- **Despite sharing common roots, CIAT and ICRISAT present their own branded approaches to landscape restoration, missing an opportunity to present a broader and better evidenced WLE approach**
- **Bilateral projects mapped onto WLE may themselves be subcomponents of bigger projects that make a larger contribution to this OT. This relationship needs to be clearly explained in Center/WLE publicity and the temptation to claim undue credit through omission avoided.**

The partners contributed to the OTs by providing necessary and sufficient sets of outputs and engagement to maintain and build momentum – see Finding 7. These outputs and their effects are described in three causal models/theories of change that describe how the set of ten OTs are working – see Appendix 1.

Part of the rationale for the existence of CRPs is to improve partnerships between CGIAR Centers. WLE has generally not played a lead role in doing so in Ethiopia. Nevertheless, ICRISAT, CIAT, IWMI and ICRAF are working together on WLE issues, as follows:

- AoC-1 - Africa RISING is playing the main integrating function bringing CIAT, IWMI and ICRISAT together to work on the same landscapes.
- AoC-2 - GIZ is playing the main integrating role through its soil work – ICRISAT and CIAT have been brought together to work on improving soil fertility and agronomy advice.
- AoC-3 - ATA played the lead role for OT-3A & 3B, while IWMI played a catalytic role in forging a strong link with a private sector supplier of solar pumps.

OT-3C represents WLE's largest investment in an OT, and the one where the program has had the biggest influence over partner selection. The OT gathered momentum when ARARI successfully applied to a WLE funding call. The fact that most of the project was led by a national research organization built strong ownership of the project findings relating to the sustainable use of exclosures. The CGIAR researcher who worked on the project argues for greater use of such funding mechanisms to build national ownership in the future.[45]

Africa RISING has brought CIAT, ICRISAT and IWMI together more as service providers than as three Centers actively seeking synergies (Finding 6). Participants at the outcome evidencing workshop suggested synergies exist. Currently, CIAT and ICRISAT present their respective approaches to improving landscapes (OT-1.1, 1.2 & 1.3) as different. However, both share common roots, and the

[45] Respondent 7

scaling of a common and more broadly applicable approach, promoted by both Centers and WLE, should happen faster.

GIZ has the potential to play a stronger and more integrating role than it does currently because it is or has provided grants to eight bilateral projects that fall under all three AoCs (see Table 4). GIZ is an implementing agency, not a donor. Therefore, integrating research and development efforts to meet country goals is part of what it does.

Some of the GIZ-funded projects are sub-grants of larger, GIZ-implemented projects. For example, the ICRISAT-led Quest for Resilience of Communities in Afar project is a sub-grant of the Afar Soil Rehabilitation Project and receives just 5% of the overall budget in pursuit of the same goal. Apparently, Centers do not always provide WLE management with this context.[46] If such links are not fully acknowledged then there is a risk of WLE exaggerating its own contribution and damaging partnerships in the process.

Table 4: Grants provided by GIZ to CGIAR Centers for work in Ethiopia

Title	Recipient
Soil protection and rehabilitation for food security, BMZ accompanying research	CIAT
BMGF-GIZ soil health and big data	CIAT
Strengthening drought resilience – agriculture sector rehabilitation project	ICRISAT
Quest for resilience of (agri-pastoral) communities in AFAR through water spreading weir-based farming and land use	ICRISAT
Developing a methodology for prioritizing soil health investments in Ethiopia	ICRISAT
Facilitating change in soil fertility management	ICRISAT
NBI – benchmarking irrigation performance and projection of irrigation water demand in the Nile Basin	IWMI

EQ 3.4 How and in what ways did WLE support or influence decision-making processes within core partners and in specific geographical contexts?

Finding 14: WLE supported the decision-making of core partners in two ways in particular:

- **By Flagship Programs producing research products, e.g. business models and synthesis of land restoration practices, that influenced the implementation of the OTs**
- **By supporting IWMI to establish itself as a reputable source of available information through IWMI's leadership of the Agricultural Water Management Platform and acting as the secretary of Agricultural Water Management Platform led by the Ministry of Agriculture**

One mechanism for WLE to influence core partner decision-making with respect to OTs in Ethiopia is through the Flagship Projects. As discussed under Finding 4, the ET found little mention of the Flagship Projects in explanations of how a Center/WLE had organized itself or contributed to the OTs. However, this is not surprising because the Flagship Projects were not conceived as 'site integrators', i.e. as mechanisms to achieve coordinated and synergistic efforts between CGIAR

[46] Respondent 48

centers and national partners. Rather, Flagship Projects were conceived to function at a global scale, generating outputs – international public goods – such as synthesis of land restoration practices and business models informed by research carried out across a number of countries (see Figure 2).

Flagship Project outputs did play an important part in the OTs, for example, the development of business models in OT-3.3 on exclosures and OT-3.2 on solar pumps. WLE publications are particularly strong on synthesis of land restoration practices. For example, a book chapter on integrated landscape restoration practices and rainwater harvesting/management in arid and semi-arid areas of Ethiopia (Woldearegay et al., 2018). acknowledges that landscape management practices in the Tigray region of Ethiopia are exemplary for Sub-Saharan Africa and beyond. Part of the OT-1.1 work on landscapes involves taking farmers and development officers to be inspired by exemplary practice in Tigray. The body of research has helped understand what works where and is underpinning the OT-1.1 approach of intelligent siting of water and fertility conserving infrastructure.

Another mechanism through which IWMI/WLE influences decision-making is by establishing itself as a reputable source of information for the Ethiopian Government. A WLE blog post credits Seyoum Getachew, the former Director of the Household Irrigation Program of ATA as saying: "Whenever we have a question about irrigation, we ask IWMI."[47] IWMI has gained this reputation and influences government decision-making by leading the Irrigation Advisory Group for the Ethiopian Ministry of Water Resources as well as acting as the secretary of the Agricultural Water Management Platform led by the Ministry of Agriculture. IWMI has signed an MOU with ATA to provide support to the piloting of solar pumping by ATA (see OT-3.2). WLE provides financial support to IWMI's engagement in both platforms.

[47] https://wle.cgiar.org/making-irrigation-technology-more-affordable-ethiopia

5. Conclusions and Recommendations

Conclusions

Conclusion 8: On the scope and potential magnitude of Center/WLE outcome trajectories in Ethiopia

The ET find that the scope and potential magnitude of ten Center/WLE outcome trajectories (OTs) is impressive for a total annual WLE investment of less than US$ 6 million in Ethiopia of which about US$1.2 million was W1/W2.[48] The full potential will come from clusters of OTs working together in three areas of change (AoCs), defined by shared causal mechanisms/theories of change which the evaluation has helped identify. All OTs have a contribution to play in reaching a possible one million households, but not by 2021 which is the WLE-Ethiopia target date.

Conclusion 9: On how WLE contributed to the outcome trajectories

WLE contributed to the OTs by developing research outputs, such as business models or soil maps, which acted as 'boundary objects'[49] to bring different stakeholders together to maximize their use and usefulness within the OT.

WLE also created an enabling environment for a WLE-Ethiopia approach based on "impact tracking." Impact tracking involves senior Ethiopian-based researchers using their professional networks to establish and move the OTs forward, using a set of behaviours akin to 'product championing.' Impact trackers are not beholden to Flagship Projects, WLE or even the Center for which they work but, as champions, are motivated by the potential streams of beneficial outcomes that their OTs might deliver.

The ET found that impact tracking has the following characteristics:

- Akin to product championing
- Well aligned with the outcome trajectory metaphor, in which champions do what it takes to start and build OT momentum to maintain and increase outcome streams for different stakeholders
- Recognises that catalytic opportunity is usually unplanned, and is likely to emerge through building partners' trust and respect over time, something that good science and impact tracking helps happen
- Makes clear to investors:
    - How long it usually takes to achieve outcomes and impact at scale
    - The quality of collaboration required to deliver a necessary and sufficient causal package to keep an OT going

[48] Figures do not exist to easily calculate WLE spending in Ethiopia. These numbers are estimated based on 2017 figures reported in the 2018 WLE Annual Report. WLE received US$ 34.4 million to work in six regions, including East Africa, of which 21% was W1/W2. Our calculation assumes that each region receives similar funding, and Ethiopia receives all of the East Africa budget. While a rough estimate, we expect that the actual figure is in this order and likely lower, given that WLE works in other countries in East Africa.

[49] See https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2663982/ for more on boundary objects

- Outcome trajectories have a history, a knowledge of which helps future planning
- The value of relatively small amounts of flexible funding to be able to respond to a catalytic opportunity

Conclusion 10: On the sustainability of the outcome trajectories

The OTs are likely to persist and develop because they are highly relevant to the development needs of Ethiopia. Construction of causal models (i.e., theories of change) for each of the three AoCs indicates positive feedback loops based on causal packages that build capabilities, create opportunities and motivate target groups to change their behaviors. The behavior change motivates others to learn about the change and replicate it themselves. Impact tracking by OT champions that are attuned to emerging opportunity needs to remain a part of the OT causal package. None of the OTs can run by themselves without some degree of subvention.

Conclusion 11: On the risk of promoting promising innovations too soon and too widely

Part of the WLE-Ethiopia approach is to work closely with government partners and the existing extension system. There are good reasons for doing this, not least to ensure local- to national-level reach and ownership, and the potential to go to scale quickly. A risk, though, is that technologies will be pushed too early and too widely before the longer-term biophysical and social consequences become evident. There is also a risk of being overly cautious and missing opportunities when they present themselves.

Conclusion 12: On how WLE engendered the outcome trajectories

The most engendered outcome trajectory (OT-3.3 on exclosures) was the one which WLE had provided the majority of the funding, and therefore presumably could exert the most influence. Elsewhere, Center/WLE gender research, and guidance derived from it struggled to change practice on the ground, despite efforts to do so that were successful in other countries. A question for WLE to consider is whether there might be an inevitable trade-off about working as part of a top-down extension system (see the previous conclusion) and addressing social inclusion issues, particularly those at intra-household level.

Conclusion 13: On missed opportunities for synergies

WLE core partners in Ethiopia are competing with each other because of a difficult funding environment for the last four to five years, despite WLE's efforts to incentivize collaboration in other ways. Competition is not conducive to synergistic research, and there is some evidence that it has deterred donors. Senior Ethiopia-based researchers are aware of synergies and want to collaborate, as they have in the past. They ask that WLE play a role in making this happen.

Conclusion 14: On who should play the 'site integration' role for WLE research in Ethiopia

Stronger site integration would help WLE core partners in Ethiopia to collaborate more. Senior core partner researchers remember that they were able to work together more synergistically under the CGIAR Challenge Program on Water and Food (CPWF). This happened because CPWF had more funding, set out to tackle a common development challenge relating to landscape and watershed restoration in Ethiopia, and had an overall coordinator to ensure site integration.

WLE has less funding than CPWF, works through Flagships that do not have a particular geographic focus, and does not have country-level coordinators. Hence, WLE should manage expectations as to how much integration it can be expected to deliver in any particular country. It should also point out that others better placed than WLE are playing an integration role. However, there is more that it can do, which is explored in Recommendation 3.

Conclusion 15: On the use of an 'outcome trajectory' as a metaphor in the evaluation

The concept of an outcome trajectory (OT) proved useful as a metaphor to help understand the contribution that WLE research has made to WLE outcomes. An OT is a slowly changing pattern of interactions between actors that deliver a stream of outcomes to those involved over time. The metaphor matches well the notion of impact tracking (see Conclusion 9) to ensure an OT keeps momentum and direction. The metaphor brings with it the useful idea of a history, or path dependency, in which what has happened before influences what is happening now and will happen in the future.

Also useful was the idea that OTs can be clustered together according to a common causal mechanism, and that this 'area of change' has a greater potential than any OT by itself. The validity of this was evident in AoC-2 where three OTs, led by three different Centers, were seen to be contributing to a greater whole, one which could save Ethiopia billions of dollars through more efficient use of fertilizer.

Recommendations

Recommendation 1: WLE-Ethiopia to keep doing much of what it is already doing

Given the impressive scope and potential magnitude of WLE outcomes, WLE-Ethiopia should better appreciate what it is doing well, and do more of it. This will include continuing to contribute to the ten OTs identified, identifying those that the evaluation may have missed, and starting new ones through good science and process facilitation. Specifically, the ET suggests that regular After-Action Reviews are carried out for each OT based on developing and revisiting timelines (similar participatory learning dynamic to the outcome evidencing workshop for this evaluation). This will allow WLE-Ethiopia staff and stakeholders to review, reflect and respond in ways that will allow WLE to exert maximum leverage with the resources it provides.

Given the importance of partnerships in the OTs, and the idea that no one organization can do it all, the WLE CGIAR Centers should become better at acknowledging the contribution of others, including the contribution of WLE. Specifically, the ET suggests developing a 'code of conduct' for acknowledging each other's contributions.

Recommendation 2: For WLE-Ethiopia to build on the concept of 'impact tracking' with support from WLE-Global

The emergent WLE-Ethiopia approach of 'impact tracking' described by key staff during the evaluation should be systematized and promoted as an international public good, applicable to other programs seeking to trigger major change with relatively little funding. Specifically, the suggestion is to publish the approach in a journal such as Agricultural Systems, Tropical Agriculture or Research Evaluation.

Recommendation 3: For WLE leadership to improve collaboration between WLE CGIAR Centers working in Ethiopia

The suggestion is that WLE identifies and selects to work on one or two synergies believed by the staff to have the greatest potential. For example, WLE could choose to support CIAT and ICRISAT to develop a common WLE-branded landscape/watershed approach. Critical to the success will be whether donors see that the common approach is more than the sum of its parts, and match this belief with more funding than either Center could have won by themselves. WLE would have to play an important role to make this happen.

Another option is for WLE to acknowledge and strengthen the integration role that others, in particular GIZ, are playing in Ethiopia. WLE leadership should question the assumption that CGIAR centers should be the ones deciding how they collaborate in a particular country. The argument should be made that these decisions should be taken by implementing agencies functioning as boundary organizations[50] across the research-development divide. Boundary organizations bring researchers together with policy and development actors to carry out collaborative work that has strong lines of accountability to both research and development. CGIAR Centers struggle to function as boundary organizations because they are much more accountable to research than development.

[50] For more on boundary organizations, see https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2663982/

Appendix 1: Areas of Change and Outcome Trajectories

The ET grouped outcome trajectories (OTs) suggested by the WLE team in Ethiopia according to the underlying causal mechanisms driving them. The underlying causal mechanisms are called 'areas of change' (AoC), of which three were identified:

1. Through development and demonstration of an approach to restoring or otherwise improving a landscape (or watershed) that encourages farmers, NGOs, the government and donors adopt and fund the approach
2. Through better use of geospatial data to transform decision making with respect to agriculture
3. Through research on and promotion of potentially transformative technology, including removing barriers to adoption.

The OTs were described in a workshop by participants responsible for championing them. The ET took the timelines and audio recordings produced as the basis to write short histories of each OT. More detail on how this was done is given in the Methodology section of this report. Those histories were drawn upon to answer the evaluation questions.

Area of Change 1: Through demonstrating landscape approaches

1A: Farmers Benefiting from the Development of Multifunctional and Resilient Landscapes

The Outcome Claim

The claim is that CIAT/WLE has contributed to the development of multifunctional and resilient landscapes in the Highlands of Ethiopia and in so doing has improved the livelihoods and nutrition security of 2000 households. The claim is based on work carried out by CIAT in eight learning landscapes in the Ethiopian highlands since 2014, including work carried out as part of the Africa RISING program.

History of the CIAT / WLE landscape work

To help validate the claim, the ET visited a learning landscape near Hossana (Jawe, Doyogena), established under the auspices of the Africa RISING program.

Africa RISING is a ten-year program led by IITA, ILRI and IFPRI that started in 2012. Phase II of the project that began in 2016 has a budget of US$50 million from USAID through Feed the Future. Phase II is working in three countries in both West and East Africa, including Ethiopia, to scale technologies to 1.1 million households in the six countries, with two thirds (0.73 million households) in Ethiopia.[51] To achieve this, Africa Rising is working with nine CGIAR Centers, including six that are part of WLE, four local universities, two federal research institutes, four woreda agricultural officers, five NGOs and four Innovation Laboratories.[52] Africa RISING works in eight kebeles across the four main highland regions (Amhara, Oromia, SNNPR and Tigray). CIAT leads Africa RISING's work on

[51] AR_phase2_program_proposal.pdf available here
[52] https://www.slideshare.net/africa-rising/ar-usaid-jun2016/2

integrated landscape management and receives funding from both Africa RISING and WLE to do so.[53] Part of Africa RISING is mapped onto WLE.

CIAT/WLE's work on developing resilient landscapes began in 2014; however, the work did not start there. CIAT's work was preceded by the Nile Basin Development Challenge, implemented by the CGIAR Program on Water and Food (CPWF). This work ran from 2010 to 2013, and aimed to improve the resilience of rural livelihoods in the Ethiopian Highlands through a landscape approach to rainwater management. [54]

Beyond the CGIAR, work has been carried out by the Ethiopian Government and a multitude of NGOs and development agencies on preventing and reversing land degradation in the Ethiopian highlands. Woldearegay et al., (2018)[55] say that from the 1970s to 2017, millions of hectares of land have been conserved through the construction of terraces and other soil and water conserving structures as well as the planting of billions of trees. Woldearegay et al., (2018) also find that these efforts have been remarkably successful in Tigray in the last decade in particular. Much of the rehabilitation work has taken place as part of government mobilizations in which every rural person from 18 to 60 is expected to work for 40 to 60 days a year on rehabilitation activities, such as building terraces.

At the core of CIAT/WLE's causal claim is a framework that helps implementers coordinate complementary interventions to restore degraded landscapes. The argument made is that success in restoring landscapes in Tigray was by trial and error,[56] which research can speed up by identifying underlying principles at work. Such understanding can guide future implementation by answering two questions. The framework also depends on providing implementers with the necessary capacities to answer them.

- What are the landscape problems and where do they occur?
- What are the solutions and where should they be placed bearing in mind downstream effects and interactions between interventions?

Other elements of the approach include developing ways of showing if interventions are working (evidence generation) and cross-site visits in particular to Tigray to inspire farmers outside of Tigray by what is possible. A visit made by farmers from Hosanna and Gudoberet sites in 2015 was particularly transformational for those involved.[57]

As part of evidence generation to facilitate targeting and scaling, the CIAT/WLE team has produced a number of publications to support the work. For instance, Tamene et al. (2017) showed the potential benefits of sustainable land management options in reducing soil loss while Ellison (2016) demonstrated what actions should be placed where, in order to generate multiple benefits. A recent

[53] In 2019, CIAT received US$ 110,000
[54] https://nilebdc.org/
[55] Woldearegay, K., Tamene, L., Mekonnen, K., Kizito, F. and Bossio, D., 2018. Fostering food security and climate resilience through integrated landscape restoration practices and rainwater harvesting/management in arid and semi-arid areas of Ethiopia. In *Rainwater-Smart Agriculture in Arid and Semi-Arid Areas* (pp. 37-57). Springer, Cham.
[56] Respondent 49
[57] Respondent 1

work by Abera et al. (2019) did extensive 'meta-analysis' to assess the benefits of different land management interventions in terms of different ecosystem services. The team assumes that such quantitative analysis can support targeting and scaling as well as enhance the negotiation capacity of the government for carbon credit and payment for ecosystem services schemes.[58]

The CIAT/WLE team has been developing the approach, supporting implementation, generating evidence, building capacity and carrying out cross-site visits for experience sharing from 2014 to the present. In Jawe at least (located near Hossana in SNNPR in the south of Ethiopia), CIAT works through the Africa RISING network of model farmers who receive and demonstrate technologies and capacity development to serve as examples to others. CIAT has been successful in securing funding from EU-IFAD to continue implementing sustainable land management, evidence generation and capacity building in the Jawe and Doyogena watersheds. The fund is also intended to package options and prepare them for scaling to similar locations.

The successful landscapes have been designated learning landscapes and have been visited by national and international experts from Ghana, Mali, Malawi and Zambia, and a high-level delegation from Tanzania that included Regional Directors in agriculture. In December 2018, a ten-member delegation from Makueni County in Kenya visited the learning landscapes as part of CIAT and WLE support to help Kenya restore 5.1 million hectares as part of its commitment to the Bonn Convention.[59] WLE's communication person invited various national and international journalists to the learning landscapes to broadcast examples of land restoration success stories.

Apparently though, adoption of water management infrastructure has been limited because other countries do not have the equivalent mobilization efforts as in Ethiopia where farmers volunteer their time to build them.[60]

In 2017, CIAT/WLE sought to engage with NGOs to share experiences and scale up the approach. This was done within the context of Africa RISING and the program's target to have scaled to nearly three-quarters of a million households by 2021. After contacting a number of NGOs within one hour's drive from the Jawe learning landscape, CIAT/WLE agreed to work with the French NGO Inter Aide. Inter Aide works in three areas in SNNPR on soil conservation and soil fertility, reaching 3300 households in 2018.[61] The NGO had worked near Hossana for more than ten years. As part of the collaboration, Inter Aide receives training of its trainers in the CIAT/WLE approach to landscape development, help with evidence generation and technologies from Africa RISING (animal feed trough and forage and green manure seeds). In return, CIAT/WLE has access to a demonstration site of good landscape management practice and a site to carry out research. Research on climate-smart technologies and carbon sequestration was carried out at this site. Africa RISING can claim that it has scaled its technologies to Inter Aide's households to help Africa RISING meet its targets. Inter Aide leadership has asked CIAT to help it identify an extrapolation domain where Inter Aide could further scale its work on a large scale.

[58] Respondent 1
[59] https://wle.cgiar.org/seeing-believing-visit-successfully-restored-watersheds-ethiopia-inspires-kenyan-officials-action
[60] 1
[61] http://interaide.org/en/cross/ethiopia-agriculture/

Added Value of WLE

WLE's contribution has been to provide funding to the work: that has largely been spent on staff salaries. The leader of the CIAT/WLE work believes he would not have been to work on the Africa RISING program without WLE support. He also said WLE support had allowed CIAT, ICRISAT and IWMI staff to continue developing the CPWF landscape approach. WLE was largely invisible in the sense that field staff understood they were working for CIAT or Africa RISING. WLE is generally acknowledged in journal articles to which the program has contributed.

Plausibility of the outcome claim

CIAT/WLE's claim to have contributed to the development of more multi-functional and resilient landscapes is fully credible based on the ET's field visit and interviews. Impact assessment has not yet been carried out to establish if the work has improved the livelihoods and nutritional security of 2000 households, but it is likely that it will, given the work is embedded in Africa RISING. Africa RISING has the target of scaling to three-quarters of a million households in Ethiopia by 2021, through working with partners.

1B: Farmers improving their soils and water supply in the Yewol Mountains

The outcome claim

The claim is that ICRISAT/WLE has helped farmers in a micro watershed in the Yewol mountains (north-east part of Amhara region) improve their soil and water supply through building water- and soil-conserving infrastructure (e.g. building terraces, spring development for small-scale irrigation, building night storage) and bringing in new crop, forage and animal varieties and breeds. The work is in the context of on-going government mobilization and food for work schemes that mobilize a significant proportion of the rural population for 60 or more days a year to build terraces to restore degraded land. Wollo University, Sirinka Agricultural Research Center and government (through the Bureau of Agriculture) led the work while ICRISAT played a catalytic role and provided technical backstopping when needed.[62]

History of the ICRISAT/WLE work

Work in Yewol began in 2011 through the award of a one-year pilot activity granted to Wollo University by the UNEP Project Adapting to Climate Change Induced Water Stress in the Nile River Basin. This was the result of the UNEP project being invited to the CPWF Nile Basin Challenge meeting in 2011 by Dr. Tilahun Amede, the CPWF Nile Basin Coordinator. The UNEP Project's approach was building key adaptive capacity and piloting adaptive capacity in areas at risk of flooding or drought with technical, policy and financial interventions.[63] Amede then facilitated the grant going to Wollo University and the selection of a watershed in the Blue Nile Basin that was susceptible to drought. The pilot was to begin rehabilitation of a micro watershed in a way that was consistent with CPWF Nile Basin Challenge approach to integrated watershed rainwater management.[64]

Work largely stopped in 2012 when the pilot ended but started again in 2014 when Dr. Amede returned from a placement in Mozambique to be based in Ethiopia. During 2011, Amede had left ILRI

[62] https://wle.cgiar.org/all-us-yewol-mountains and interviews
[63] http://hdl.handle.net/20.500.11822/230, p1.
[64] Merrey, D. and Clayton, T. 2013. A new integrated watershed rainwater management paradigm for Ethiopia: Key messages from the Nile Basin Development Challenge. NBDC Brief 14. Nairobi, Kenya: ILRI.

for ICRISAT and the CPWF Nile Basin Challenge had closed in 2013. WLE took over some of the CPWF's sites and key learning. Amede was able to use WLE funding to support Wollo University to continue the rehabilitation work. Through having good links to Wollo University and government, Amede was able to facilitate the partnership between Wollo University, Sirinka Agricultural Research Center and different levels in government. This allowed for the work to be coordinated with government mobilization and food for work schemes, supported by agricultural offices at district and kebele level.

Rehabilitation work began at the top of the micro watershed, at the top of the Yewol Mountain at more than 3600m. Here, degraded common grazing land was terraced using mobilization and youth employed through a food for work scheme. Terraced land was subsequently allocated to youth groups who were given the opportunity to plant and care for apple trees and potatoes. Terracing continued in the middle of the watershed and springs upgraded with canals built from them to allow irrigation during the dry seasons. A large effort went into planting trees, including the introduction of Acacia decurrens, to halt gully erosion while providing leaves that can be used as a forage or green manure. The community also agreed to halt the practice of open grazing during the dry season to allow grasses –planted to stabilize terraces – to become established, as well as to conserve organic matter in the soil.

The ET found that farmers in the micro watershed were generally happy with improvements made, claiming the following benefits:

- A change in mindset from working individually concerned only about one's own farm to working collectively for the benefit of the overall landscape
- More crops are grown in the dry season as a result of stronger springs in the mid-section of the watershed and more irrigated area at the bottom of the watershed
- A greater variety of crops planted
- More potatoes grown as a cash crop by youth, helped by the building of storage for seed potato
- Introduction of an improved breed of sheep that commands a higher price at market
- Rich farmers' animals no longer graze their fields during the dry season.

The stronger springs and expansion of irrigated area at the bottom of the watershed, claimed to have increased from 240ha to over 900ha, was because the terracing had slowed down run-off allowing for greater infiltration and an increase in the level of the water table.

Interviewees also indicated some concerns, including:

- Landless youth or women can no longer fatten sheep as a livelihood activity, due to the bylaw stopping open grazing in the dry seasons;
- Difficulties in equitably sharing the benefits from the improved irrigation infrastructure and greater quantities of water becoming available during the dry seasons.

Despite WLE's contribution to guidance on how to carry out inclusive irrigation interventions,[65] the ET found little evidence that steps were being taken to understand and address potential access and equity issues affecting women, youth and the landless in the micro watershed. Amede did say that efforts were being made to engage an ICRISAT social scientist to accompany the work.

Visually, the work in the watershed is impressive – more and better terracing and tree planting in gullies are clearly visible compared to neighbouring land. The partners use the watershed as a learning watershed, in a similar way to CIAT's learning landscapes in Jawe, as described in OT-1A. In early 2018, the Deputy Prime Minister of Ethiopia and six ministers visited the site by helicopter during a field day for 1000 farmers. Wollo University is eager to secure funding to expand the work into other micro watersheds, kebeles and districts.

Added Value of WLE

WLE's funding has largely been used to support Wollo University and local partners. Amede said that without WLE, and its emphasis on landscape restoration in Ethiopia, ICRISAT would not have allocated its own discretionary funding to work on a watershed in Ethiopia. Similar to CIAT's landscape work, WLE was largely invisible in the sense that field staff understood they were working for Wollo University, not ICRISAT or WLE.

Plausibility of the outcome claim

ICRISAT/WLE's claim to have contributed to improving the soils and water supply in a micro watershed in the Yewol mountains is fully credible, based on the ET's field visit and interviews. The work is with a kebele made up of 884 households, of which one third are headed by women. The micro watershed is being used for demonstration purposes and the ET found strong anecdotal evidence that aspects of the approach are spreading to other kebeles and beyond.

1C: Dryland pastoralists engaging in agriculture by harnessing floodwaters

The outcome claim

The claim in the WLE Outcome Impact Case Reports for 2018 is that ICRISAT, in collaboration with GIZ and supported by WLE, has demonstrated an integrated flood management strategy in the Afar Region of Ethiopia that converts the extreme floods emerging from the highlands to productive use in agro-pastoral systems through water-spreading weirs.[66] The Government of Afar has adopted the approach.

History of the ICRISAT/WLE work

Water spreading weirs were first introduced into Afar by a pilot project implemented by GIZ. Three weirs were built and tested. On the basis of the results, a larger Euro 16.45 million project began in 2014 to run until 2022, called the AFAR Soil Rehabilitation Project.

The idea to use water spreading weirs in Afar came from Chad where they were first introduced by Swiss cooperation in the 1990s. Water spreading weirs are structures that span the entire width of a valley to spread floodwater over the adjacent land area. They slow the floodwater down and allow it

[65] http://www.ifpri.org/publication/considering-gender-when-promoting-small-scale-irrigation-technologies-guidance-inclusive

[66] WLE_OICRS_2018AnnualReport 28 April 2019.docx available here

to infiltrate and deposit any nutrients it carries. Thus, the weirs can be used for agriculture, for trees, for fodder or for raising the water table by increasing water infiltration.[67]

The Afar Soil Rehabilitation Project, funded by the German Government, installed a cascade of water spreading weirs in Chifra in 2015. The project subcontracted ICRISAT/WLE to assess how best to cultivate and manage this newly cultivatable land. ICRISAT researchers developed recommendations on what forages and crops to grow when and where, based on GIS maps of water and nutrient deposits. The recommendations were implemented in consultation with local communities. As a result, by 2017, 46 hectares of elephant grass, pigeonpea, mung bean and lablab crops were introduced.[68] ICRISAT receive about Euro 100,000 a year, roughly five percent of the project budget for the work. Other partners involved in the work to identify, prioritize and integrate best-bet agricultural practices and crops on the newly cultivatable land include Wollo University, Woldya University and the Afar Pastoral and Agri-Pastoral Research Institute (APARI). GIZ, through a livelihood team, are responsible for building and maintaining the weirs.

The work in Afar has received a lot of attention, mainly through the communication efforts of ICRISAT. In 2019, ICRISAT produced a policy brief, co-authored by partners including GIZ, suggesting that weir technology could benefit 3.5 million hectares in Afar, Somalia region and the Omo-Gibe basin.[69] The Brief also says that the Ethiopian Bureau of Pastoral Agriculture and Development is expected to take up the oversight and outscale the technology to multiple communities.

A large US$ 456 million World Bank project was scheduled to start in 2019 to improve livelihood resilience of pastoral and agro-pastoral communities in Ethiopia. The project document identifies soil and water conservation together with small-scale irrigation, improved extension and improved crop and forage productivity as priorities for agro-pastoralism, which are all areas of work of the Afar Soil Rehabilitation Project. The document says that this project's approach merits scaling up.[70] ICRISAT was involved in the development of the project proposal.[71]

Weirs have been promoted despite some concerns with the maturity and sustainability of the technology. Handover of the first ICRISAT site at Shakeburo to government partners was not a complete success, as a well-capacitated government backstopping team was not in place. This was because of some contractual issues involving construction of the weirs.[72] The establishment of a backstopping team is a priority. In the meantime, ICRISAT continues to provide limited support to Shakeburo, and to monitor progress. Apparently, cropping is changing to produce crops that have more biomass for fodder.

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[67] https://qcat.wocat.net/en/wocat/technologies/view/technologies_1536/
[68] https://cgspace.cgiar.org/rest/bitstreams/168844/retrieve
[69] Tilahun Amede, Elizabeth Van den Akker, Wolf Berdel, Christina Ketter, Gebeyaw Tilahun, Asmare Dejen, Gizachew Legesse, Hunegnaw Abebe and Mezgebu Getnet. 2019. Flooding events turned into farming opportunities: Innovation transforms livelihoods of pastoralists in Ethiopia. Policy Brief 13, ICRISAT
[70] http://documents.worldbank.org/curated/en/849011553174003078/pdf/Project-Information-Document-Integrated-Safeguards-Data-Sheet-Lowlands-Livelihood-Resilience-Project-P164336.pdf
[71] Respondent 5
[72] Ibid

A view in GIZ is that more research is needed to be done on rates of sedimentation behind the weirs, and on the regularity or otherwise of flooding. GIZ has separately funded ICRISAT to map flooding to improve the siting of weirs.[73]

Another concern is community willingness to take responsibility for the weirs, given a long history of dependency in the area. ICRISAT's approach has been to do what it takes initially to establish a demonstration site, including paying for land preparation, fencing and guarding of the site. This is somewhat at odds with the GIZ view that benefiting communities should contribute something. GIZ is concerned that payments create an expectation that other weirs will enjoy similar subsidy, thus limiting community ownership and future prospects of sustainability and scaling. ICRISAT respond that they make subsidizing payments only in the first year or so.[74]

Added Value of WLE

WLE's contribution has been to support salaries of ICISAT staff.

Plausibility of the outcome claim

The outcome claim that ICRISAT/WLE can plausibly make is that with partners it has played a leadership role in developing and showcasing agricultural practices on newly cultivatable land adjacent to water spreading weirs. GIZ led with the idea to transfer weir technology from West Africa, and was responsible for them being built. ICRISAT/WLE can also legitimately claim that it has taken a central role in promoting the broader use of the technology across millions of hectares. However, with this claim comes the risk that ICRISAT/WLE promoted the technology prematurely, with potential negative consequences.

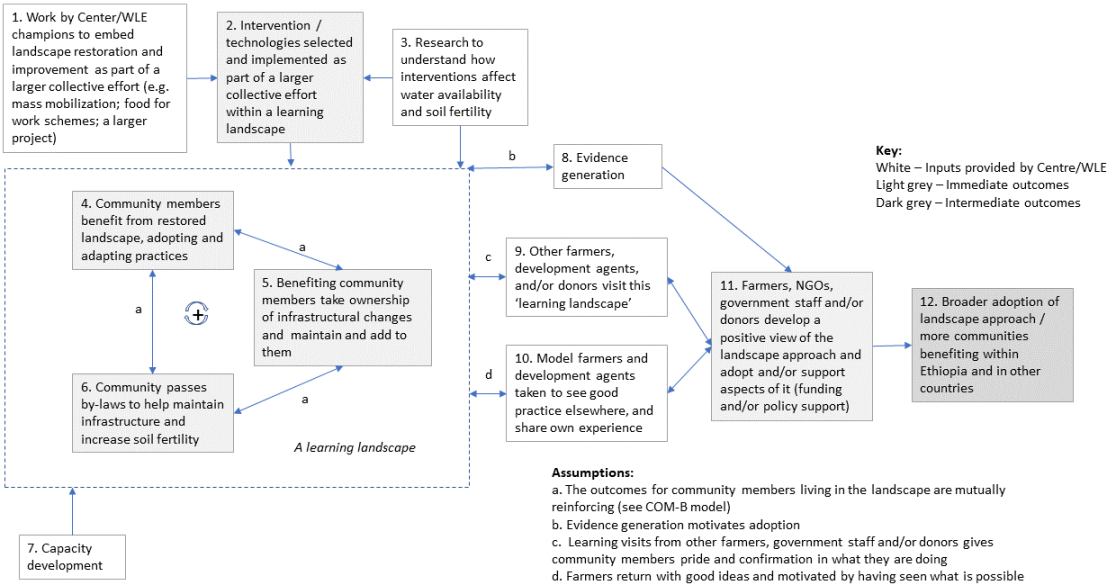
Common theory of change underpinning the landscape outcome trajectories

Figure 5 shows the theory of change underpinning the three landscape OTs. The numbers in the description of the theory of change below relate to the boxes shown in the model.

Figure 5: Causal model of how the landscape outcome trajectories are working

[73] Respondent 38

[74] Respondent 5



The dynamics shown in the ToC begin with the Center/WLE champion or champions pushing to carry out land rehabilitation/improvement by taking a landscape/watershed approach to land restoration, as indicated in the WLE proposal. Some of the champions had experience developing and working with a landscape approach that was the main output of the CPWF work in the Nile Basin from 2005 to 2013.

As a landscape approach requires engagement of actors at different institutional levels and geographic scale (farmers, communities, kebele, woreda and regional government, donors), the champions work to embed the approach in a larger collective effort, i.e., mass mobilization by the government, food for work schemes and/or large multi-partner projects. The work may also involve partnering with NGOs that are already working on aspects of landscape restoration (e.g., Inter Aide).

Interventions are identified and agreed with community leaders, model farmers and partners. Intervention initiates a dynamic represented by the interaction between three outcomes (4, 5 & 6).

When improvements in the landscape is sufficiently visible and understood, Center/WLE brings farmers, government staff and/or donors so see and learn from the work. This provides community members with positive feedback. Community members and local staff also have the opportunity to visit other learning sites which can be very motivating (e.g. trip made by Hossana farmers to Tigray).

Monitoring, evaluation and evidence generation, at times informed by research being carried out within the landscape, support learning and helps improve the multi-functional performance of the landscape. Evidence generation helps farmers, NGOs, government staff and/or donors develop a positive view of the landscape approach leading to broader adoption. The hope is that this will include continued funding for the work in the learning landscape, in particular for the construction of terracing and other infrastructure that communities cannot afford on their own.

The long-term hope is that sufficient decision-makers support the landscape approach such that it becomes mainstreamed into government and NGO land restoration programs.

Area of Change 2: Through use of geospatial data

This area of change consists of four OTs, the first three of which are part of a larger body of work in part coordinated by the GIZ project "Supporting Soil Health Initiatives in Ethiopia" running from November 2018 to June 2020, and likely to be granted a second phase. The GIZ project is funding two of the OTs (CIAT and ICRISAT). The goal of GIZ project is to support the better use of geospatial soil, agronomy and health data to transform agriculture in Ethiopia. The first three OTs are considered together.

2A: Soil-plant spectral technology guiding soil fertility investments in Ethiopia

The outcome claim

The outcome claim made as part of a 2018 WLE Outcome Impact Case Report[75] is that Ethiopia is using soil-plant spectral technology developed by ICRAF/WLE and partners to map and monitor soil properties, develop fertilizer recommendation and drive policy to transform agriculture. Ethiopia has established a state-of-the-art soil information system based on the technology. This is in the context of strong political support to improve site-specific fertilizer recommendations in Ethiopia and a coordinated effort, in part funded by BMGF, to pull together existing soil data to do so. Soil spectroscopy is a rapid way of analysing key soil properties based on the fact that infrared spectra hold information on its organic and inorganic materials. Its attraction is that it can analyse soil samples faster and more cheaply than so-called traditional 'wet' chemistry methods, which is a huge advantage when covering large areas.

History of the ICRAF/WLE work

ICRAF established its Soil-Plant Spectral Diagnostics Laboratory in 2000. Work on soil spectroscopy began in earnest with the publication of a ground-breaking paper in 2002[76]. Over the following decade, ICRAF has helped popularize and mainstream the technology by setting up 30 spectral labs across 16 African countries.[77]

In 2011, ICRAF worked with the Africa Soils Information Service (AfSIS) and the Ethiopian Agricultural Transformation Agency (ATA) to set up Ethiopian Soil Information System (EthioSIS) to use satellite technology and spectral analysis to create comprehensive digital soil maps in Ethiopia. EthioSIS received funding from the World Bank Agricultural Growth Program (WB-AGP), the UN Development Program (UNDP) and the Bill and Melinda Gates Foundation (BMGF). From 2013 to 2017, ICRAF-WLE provided six training events for EthioSIS on soil spectroscopy and digital mapping, as well as on-the-job training for EthioSIS on soil spectroscopy and its application to digital soil mapping, remote backstopping on spatial prediction of soil properties, use of machine learning, laboratory workflows, quality control, and soil archiving and data bases. ICRAF helped EthioSIS establish spectral

[75] https://marlo.cgiar.org/projects/WLE/studySummary.do?studyID=2794&cycle=Reporting&year=2018
[76] Shepherd KD and Walsh MG. (2002) Development of reflectance spectral libraries for characterization of soil properties. *Soil Science Society of America Journal* 66:988-998. doi:10.2136/sssaj2002.9880
[77] http://worldagroforestry.org/sites/default/files/u897/ICRAF%20Network%20of%20Dry%20Spectroscopy%20Labs_2018.04.03.pdf

technology at the ATA/National Soils Testing Center and five satellite laboratories at Nekmte, Jimma, Hawassa, Bahir Dar, and Mekelle.

With this and other significant support, EthioSIS generated a large amount of soil fertility data from Ethiopia, generating and publishing soil fertility status and fertilizer type recommendation maps on request, as well as contributing data to the 250 m soil properties map of Africa[78], the first of its kind. EthioSIS has established an AfSIS soil spectral Library containing 10,561 spectra by 2019.

The soil fertility statue maps were used to refine fertilizer recommendations, and improved crop responses were registered from the massive demonstration trials conducted at farmers' and farmers training centers' fields. Establishing optimal fertilizer formulations and application rates for specific soil and crop types is critical for increasing overall yield improvements.[79] While a digital soil map indicates what nutrient may be deficient, crop response trials are needed to calibrate and validate soil tests. According to a knowledgeable and independent informant,[80] and a substantive body of international literature, soil spectroscopy is good and highly reproducible at predicting some soil properties, but not others. In addition, there are challenges with calibration posed by large reproducibility problems in the wet chemistry data. In order to use the tool in Ethiopia as a whole, there is a need to calibrate and validate spectral datasets using a gold standard wet chemistry laboratory on hundreds of soil samples. This has been done in other countries by a private Dutch company – AgroCares – initially trained and technically backstopped by ICRAF. AgroCares is currently providing soil testing services to farmers using spectral technology in Kenya. Calibration of the AfSIS spectral library would cost an estimated US$ 500,000.

GIZ is supporting a project "Supporting Soil Health Initiatives in Ethiopia" running from November 2017 to June 2021, and likely to be granted a second phase. The goal of the project is to help coordinate the creation of an integrated database of soil and agronomic data to allow advisory services to provide optimal site-specific recommendations to improve soil health and fertility. The development of this capacity is a national and donor priority, as evident in the Joint Summit on 'Soil Fertility to Scale' held by the Ethiopian Institute of Agricultural Research (EIAR), the Sustainable Intensification Innovation Lab at Kansas State University, USAID, ICRISAT and IFDC. The Ethiopian government, through the WB-AGP and USAID, has invested in five fertilizer blending plants in the country, which are not yet resulting in demonstrated increases in yield.

Added value of WLE

The demand for the support of ICRAF's Soil-Plant Spectral Diagnostics Laboratory is large and has outstripped supply in Ethiopia and other countries. WLE funding has been helpful in allowing the laboratory do more than it otherwise could, through supporting salaries, capacity development and equipment purchases.[81] WLE support is invisible in so far as EthioSIS is concerned.

[78] Hengl T, Leenaars JGB, Shepherd KD, Walsh MG, Heuvelink GBM, Mamo T, Tilahun H, Berkhout E, Cooper M, Fegraus E, Wheeler I, Kwabena NA. 2017. Soil nutrient maps of Sub-Saharan Africa: assessment of soil nutrient content at 250 m spatial resolution using machine learning. *Nutrient Cycling in Agroecosystems* 109:77–102. DOI 10.1007/s10705-017-9870-x

[79] Respondent 40

[80] Respondent 39

[81] Presentation made at outcome evidencing workshop, 6 September, 2019

Plausibility of the outcome claim

ICRAF/WLE can claim that it has made an important contribution to the development of EthioSIS in Ethiopia, and by extension, to the soil maps that EthioSIS has generated. However, more work is required before Ethiopia has a system in place that can save potentially hundreds of million dollars by providing farmers with quick, cheap and accurate fertilizer recommendations for their fields. Part of this work includes the calibration of the soil spectral library created by EthioSIS.

2B: Ethiopia adopts a new soil strategy to target soil fertility management interventions in various landscape niches

The outcome claim

The outcome claim is that ICRISAT/WLE has developed a decision guide that fine-tunes fertilizer recommendations by taking into account position in the landscape, and that the approach has been adopted in a national soil management strategy. This is in the context of mixed results in attempting to improve on blanket fertilizer recommendations by using EthoSIS-developed soil maps.

History of the ICRISAT/WLE work

For 50 years, Ethiopia has been applying only urea and phosphorous to manage soil fertility. Farmers decided on how much fertilizer to apply based on blanket recommendations.

Soil surveys and analysis carried out by EthioSIS (see above) identified lack of other nutrients such as sulphur, boron, potassium, zinc and copper. In 2014 and 2015, USAID supported the establishment of several fertilizer blending plants to produce fertilizers containing these nutrients, the application of which were guided by recommendations derived from EthioSIS' soil maps. Farm trials showed that yield increases of up to 80% were possible for wheat, maize, barley, teff, chickpea and sesame.[82] However, when farmers used the fertilizers, results were mixed with some farmers complaining about being charged more for fertilizer that did not work.

Partly in response, ICRISAT promoted the idea of adjusting the new recommendations according to position of fields in the landscape. For example, it is common that at the top of a watershed, soil has become acidic and as a result crops do not respond to fertilizer. Here the recommendation would be to first reduce the acidity by adding lime.

In 2016, ICRISAT and partners were invited to present early results at EIAR by its Director General as the idea started to gain traction. In 2017, the Africa RISING project (see Outcome Trajectory on Landscapes) provided the opportunity to work with 500 farmers to generate data on crop response to fertilizer at different positions in the landscape. ICRISAT/WLE also carried fertilizer trials in the Yewol micro watershed (see Outcome Trajectory on Yewol). ICRISAT/WLE developed a first version of a decision guide that in 2018 was presented to the Minister of Agriculture and the ATA Director. In 2019, with funding through GIZ, ICRISAT/WLE collected more data in Oromia, Amhara and Tigray regions so as to develop a second version of the guidelines. ICRISAT/WLE plan to develop an App to be used on smartphones to provide guidance in a user-friendly manner. Such an App will benefit from other efforts to bring all soil fertility and agronomy data into one database, together with ways of using it to provide location-specific recommendations.

[82] https://2012-2017.usaid.gov/ethiopia/news-information/press-releases/new-fertilizer-blending-facility-opens-ethiopia

Another group that responded to the poor reaction to improved soil maps was the Ethiopian Society of Soil Science. From its membership, a 'coalition of the willing' formed to work collectively to push for a National Research Strategy on Soil Fertility and Health, approved in 2016, and an overall strategy for soil fertility and health in the following year.[83] The concept of adjusting fertilizer recommendations was included in the former.[84]

Added Value of WLE

WLE's contribution has been to support salaries of staff.

Plausibility of the outcome claim

ICRISAT/WLE can claim that it has developed a first version of a decision guide providing crop and soil specific nutrient advice in landscapes. A second version is being developed which will benefit from an effort to bring all soil fertility, agronomy and health data together (seen next OT). The work is relevant to the broader effort to transform agriculture through better use of data. The work has informed part of a national research strategy on soil fertility and health.

2C: Contribution to the Ministry of Agriculture approving a soil and agronomy data sharing policy key to agricultural transformation in Ethiopia

The outcome claim

The outcome claim is that CIAT/WLE has contributed to the development of a national soil and agronomy data sharing policy to support a 'big data' approach to improve farm level soil fertility advice. This is in the context of concerted efforts to improve crop response to soil treatment based on the use of the large amount of soil and agronomic data that exist in the country.

History of the CIAT/WLE work

When EthioSIS started to carry out soil surveys and produce soil maps, a number of organizations and individuals asked to be allowed access to the data sets. EthioSIS was reportedly slow in meeting the requests largely due to a lack of a data sharing policy and guidelines.[85] Various bilateral discussions took place to resolve the issue but progress was limited until 2015, when CIAT/WLE, supported by GIZ, held more than five awareness creation meetings to facilitate data sharing, including the potential of 'big data' analytical approaches which require data sharing to work. CIAT/WLE, together with the EIAR,[86] played a leadership role in establishing a coalition of the willing to bring together about 50 individuals from a wide range of organizations who volunteered to share data and support the process of collective data sharing. The coalition of the willing met in February 2018 and then held a stakeholder consultation workshop in April 2018 at which a task force was set up. The task force hired a consultant to develop a set of data sharing guidelines that were presented back to the coalition of the willing in December 2018. While this exercise was ongoing, the Ministry of Agriculture noted the potential and constituted a national taskforce, made up of several coalition of the willing task force members, to develop a national soils/agronomy data sharing policy. The taskforce with support from GIZ and international consultants (CABI, ODI), developed a national soils/agronomy data sharing policy that was endorsed and launched at a national workshop held in June 2019. After the endorsement of the policy, various organizations received letters from the

[83] Respondent 40
[84] From presentation made at outcome evidencing workshop, 6 September, 2019
[85] Respondent 1
[86] Respondent 40

Ministry to request them to share their data. CABI is to be brought in to help organizations adapt the data sharing guidelines to their needs and context.

Adhering to a common set of data standards is key if data sets are to be amalgamated and work together. In December 2018, a data standardization task force was set up. In September 2019, while the ET was in Ethiopia, a workshop was held to develop data standardization guidelines for ratification in December. The workshop was organized by CIAT and GIZ.

Since 2015, much of the work has been supported by the GIZ-led Integrated Soil Fertility Management (ISFM+) project, specifically by a sub-project called "Supporting Soil Health Initiatives in Ethiopia." The ISFM+ project has a budget of 17.5 million Euros, nine years duration, 20 staff members and 24 sub-grant agreements with governmental research and extension organizations and seven international research institutions (Mannheim University, Wageningen University, Teagasc, CIMMYT, IFPRI, CIAT, ICRISAT). The project receives US$ 1.5 million from BMGF, with most of the rest coming from the German Government (BMZ).[87] CIAT has a sub-grant agreement to work on data sharing and upgrading databases (this OT) and provide training on machine learning and big data analytics. CIAT will also support building the database including necessary co-variates. ICRISAT has a sub-grant to work on how position in a landscape influences fertilizer recommendations (previous OT) and will receive a new project to help government prioritize where investments in soil fertility are made.[88]

Added value of WLE

WLE funding has been used to support the time of staff working on data sharing policy. The GIZ ISFM+ project does not identify WLE as a partner.

Plausibility of the outcome claim

CIAT, with the expertise it has from taking over the Tropical Soil Biology and Fertility Institute in Kenya, can claim that it has provided good support to the development of a national soil and agronomy data sharing policy, and beyond this, to help with data standardization and upgrading databases. This work is part of taking a 'big data' approach by a 'coalition of the willing' to ensure that farmers can receive better advice on what type and level of soil treatment they should apply. Such an approach could save Ethiopia billions of dollars in wasted fertilizer and help reduce soil depletion and acidification on millions of hectares of cropland.

This and the previous two OTs are part of a bigger endeavour to transform agriculture in Ethiopia by providing better advisory services to farmers regarding soil fertility and agronomic practices. The endeavour is a high priority for the Ministry of Agriculture and ATA. It is supported by a number of donors, including USAID, BMGF and the German Government, and coordinated by a well-funded GIZ project. CIAT and ICRISAT have been receiving funding through GIZ and WLE for their work.

2D: Ministry of Agriculture makes an inventory of the area under irrigation in Ethiopia

The outcome claim

The claim is that mapping by IWMI/WLE of irrigated areas in Ethiopia produced a lower estimate than that quoted in NPD1. This led to the Regions carrying out their own mapping that produced

[87] Project manager's Linked-In page

[88] Respondent 40

estimates closer to the IWMI/WLE estimates, and less than half that of the previously-used figure. It is also claimed that the experience has helped in creating a culture where government staff are unafraid to challenge old estimates based on new types of analysis.

History of the WLE/IWMI work

In 2014, IWMI challenged Ministry of Agriculture estimates of irrigated area used in the National Development Plan (NDP1). The estimate of 2.65 million hectares was much higher than estimates in the FAO global irrigation map. IWMI championed the idea of using a combination of remote sensing and GPS mapping to help resolve the issue, and to this end started training regional and federal experts on how to do it in 2017. In the same year IWMI/WLE finalized the mapping and came up with a figure of 1.3 million hectares of irrigated land, roughly half the NDP1 estimate. IWMI/WLE presented the results to the State Minister of Agriculture, as requested by the Director of Irrigation, following a presentation made to the Agricultural Water Management Platform. As a result, the Minister ordered the Director of Irrigation to work with the Regional Governments to map actual irrigated areas using GIS and remote sensing. This work came back with an estimate somewhat lower than the IWMI/WLE estimate. These new figures are being used by government and international organizations, for example, by the Water Resources Institute.

The significance of the work is that the Ministry of Agriculture made it clear that regions should report reliable data, and not be held to old estimates that may have had errors in their computation.

Added value of WLE

WLE funding has been used to support all aspects of the work, including the time of staff working the revised estimate of irrigated land area, as well to train federal and regional experts.

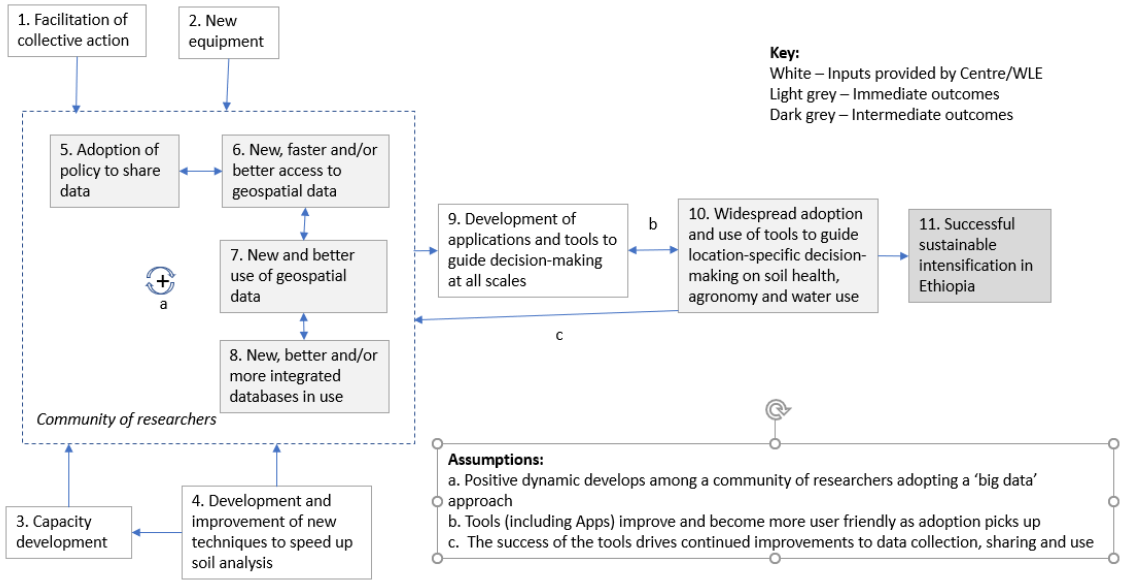
Plausibility of the outcome claim

The ET had hoped to speak with the State Minister responsible for requesting the Department of Irrigation to remap irrigated areas. Nevertheless, it is a fact that the State Minister did make this request and the new figures are being used. There is also no reason to doubt the claim that IWMI/WLE has built capacity among regional and federal staff in remote sensing and GPS mapping. What is less easy to verify is the claim that this has contributed to a more open reporting culture. It is also not yet clear what effects a halving of estimates of irrigated area will have on policy and practice within Ministry of Agriculture. It could, for example, lead to increased investment in irrigation.

Common theory of change underpinning the data use outcome trajectories

Figure 6 shows the theory of change underpinning the four data OTs. The numbers in the description of the theory of change below relate to the boxes shown in the model.

Figure 6: Causal model of how the data use outcome trajectories are working



At the center of the causal model is a community of researchers sharing a common desire to use big data to improve decision-making in agriculture in Ethiopia. The model covers two endeavours: to provide farmers and their advisors with tools that will help them make better fertilizer and agronomy decisions; and, accurate mapping of irrigated areas in Ethiopia to help with government planning.

The outcome driving the model is that new and better collective use of geospatial data (7) leads eventually to the widespread adoption and use of tools to guide location-specific decision-making on soil health, agronomy and water use (10). Key to (7) is a new policy to support sharing of soil and agronomy data (5), without which Ethiopia-wide tools are not feasible. Wider adoption of the tools is expected to help bring about successful sustainable intensification.

Area of Change 3: Through transformative use of technology

3A: Contribution to the Prime Minister of Ethiopia approving a policy to make all agricultural equipment exempt from taxation

The outcome claim

An IWMI-led project recommended tax exemption on water lifting technologies. The recommendation was picked up by ATA and eventually approved by government for all agricultural technology, although not yet implemented.

History of the IWMI/WLE work

In 2009, the Agwater Solutions Project began, led by IWMI and funded by BMGF with the aim of supporting farmer-driven investments in agricultural water management. In 2011, the project presented findings to stakeholders in Ethiopia, including Seyoum Getachew, Director of the Household Irrigation Platform in ATA. The main message was that an additional two million hectares of land could be brought into production if farmers had better access to affordable pumps. Pumps were not affordable, in part because more than one third of their price was tax.[89]

[89] http://www.iwmi.cgiar.org/2019/07/making-irrigation-technology-more-affordable-in-ethiopia/

In 2013, ATA carried out an in-depth analysis of the experience of Bangladesh in exempting agricultural equipment from tax, and subsequently recommended tax exemption for small-scale pumping equipment to the Transformation Council of the Federal Government.

In 2015, the Prime Minister's Office requested a feasibility study on tax exemption for all agricultural equipment. A final feasibility study was carried out in 2017, after which the Transformation Council made the decision to exempt all agricultural equipment from import tax, despite the large loss in revenue that this would result in.

In 2018, the Prime Minister's Office instructed the Ministry of Finance to implement the tax exemption and in May 2019 implementation was approved by the Ministry of Finance. IWMI has been asked to put together implementation guideline scenarios for how tax exemption would benefit farmers on the ground and not just importers and retailers of irrigation equipment. Once these guidelines are developed, they will be presented to Ministry of Agriculture and Ministry of Finance. As of September 2019, tax exemption had not been implemented. ATA asked IWMI to develop the guidelines because of its history of working on agricultural water management in Ethiopia, and because of the close working relationship established with ATA.[90] However, IWMI/WLE was unable to respond to the request because of lack of funding.

Contribution of WLE

WLE helped finance and keep the work progressing since 2012. The recommendation to remove tax from irrigation equipment happened before WLE began.

Plausibility of the Outcome Claim

It is plausible that ATA acted on the findings of the Agwater Project, as the main protagonist Seyoum Getachew, former director of ATA's Household Irrigation Program, attended the outcome evidencing workshop and confirmed that this was the case. The main claim, that tax has been removed from agricultural equipment, has not yet happened.

3B: Large scale piloting of solar pumps by ATA

The outcome claim

IWMI/WLE, through support to the piloting of solar pumps in three projects (LIVES, ILSSI and Africa RISING), contributed to the decision by ATA to pilot a larger number of pumps (160) in 14 Districts in Ethiopia and helped broker a good working relationship between ATA and the private sector supplier, Solar Development.

History of the IWMI WLE work

In 2014, three projects[91] were involved in piloting small 80-Watt solar pumps from India. IWMI/WLE supported all three by recording data to allow for economic, social, environmental and institutional analysis of their performance.[92] IWMI also provided training to field staff tasked with collecting data and maintaining the pumps.

In 2016, a solar pump supplier, Solar Development, made contact with IWMI because they planned to sell the same pumps. IWMI/WLE was able to provide valuable information on expected return on

[90] Ibid

[91] Africa RISING, LIVES and ILSSI

[92] http://www.iwmi.cgiar.org/Publications/IWMI_Research_Reports/PDF/pub172/rr172.pdf

investment for different use scenarios. Solar Development invited IWMI in one of its own capacity development events. ATA participated as a trainee. A relationship then developed between IWMI and Solar Development in which IWMI passes on potential customers on to Solar Development while the company provides a good aftersales service. The company say they have sold over 400 of the 80-Watt pumps, many of which came through IWMI.

At the same time, IWMI developed a relationship with ATA culminating in an MoU between the two organizations signed in June 2017. In 2017, IWMI/LIVES (Livestock and Irrigation Value chains for Ethiopian Smallholders) presented business model scenarios for solar pumping on the Agricultural Water Management Platform. ATA carried out assessment of the potential for shallow ground water irrigation, with technical support from IWMI (particularly the review of technical reports delivered by consultants). The assessment led to the decision to provide solar pumps to 160 households for demonstration purposes. These will be larger capacity submersible pumps better able to pump water up to a header tank for drip irrigation in the morning and evening. The pumps were to be installed from November 2019, supplied by Solar Development.

As part of the MOU with ATA, IWMI will carry out an impact assessment and to this end has completed a baseline survey of 160 households. IWMI is also providing technical support and backstopping during the piloting, subject to the availability of funding from the Africa RISING program or WLE.

Contribution of WLE

WLE funding has paid for some of the salaries of IWMI staff working on piloting the solar pumps. WLE funding has also helped with the preparation of solar pumping business models and in carrying out the baseline survey. WLE's contribution is somewhat invisible: for example, WLE funding is not mentioned as part of the MOU between IWMI and ATA, while Africa RISING's is highlighted. This is because WLE support came at a later stage as the funding from Africa RISING was not sufficient.

Plausibility of the causal claim

IWMI/WLE can plausibly claim that they contributed in a pivotal way to the decision to pilot 160 solar pumps by ATA. The two organizations have signed an MOU, so IWMI can plausibly claim it will continue to provide technical backstopping to the pilot. IWMI/WLE has helped create a more enabling environment for solar pumping by providing test data to a private sector supplier, enabling that company to provide a better service.

The claim that the piloting is large scale is maybe somewhat exaggerated. For example, in India a government pilot program aimed to install 50,000 larger capacity pumps over five years.[93]

3C: Exclosures increasingly used as a source of sustainable economic benefit by women, youth and landless

The outcome claim in context

The claim is that a WLE-funded project, led by the Amhara Regional Agricultural Research Institute (ARARI), has contributed to a paradigm shift in which exclosures are increasingly used as a source of sustainable economic benefit for women, youth and the landless. Exclosures are degraded areas, often on hillsides, that are closed to humans and domestic grazing animals so as to allow natural

[93] https://energypedia.info/wiki/Photovoltaic_(PV)_Pumping_in_India#cite_note-5

regeneration. Exclosures have been extensively established in Ethiopia since the 1980s. In Tigray, one sixth of the land area is taken up by exclosures (895,220 / 5,363,800ha). Pressure has increased over time to allow the sustainable use of enclosures. Exclosures are associated with a number of trade-offs: for example, land is restored on one hand, while neighbouring land may come under greater grazing pressure and deteriorate faster.

History of the ARARI/WLE work

ARARI successfully applied to the WLE Regional Program to fund a project called: "Sustaining Land Management Interventions through Integrating Income Generating Activities, Addressing Local Concerns and Women's Participation." The project began in 2015 to run for two years, with a budget of US$ 590,000. The project was led by Amhara Region Agricultural Research Institute (ARARI), with Bahir-Dar University, the Regional Bureau of Agriculture and IWMI as partners. The project worked in eight watersheds and developed a catalogue of income generating activities that could be sustained by exclosures and later a report exploring business model scenarios and models. Another small project, funded by WLE, carried out mapping of where exclosures may be suitable.

To reduce trade-offs the project supported women, youth and landless to engage in income generating activities, based on exclosures, including beekeeping, livestock fattening and planting fruit trees. Forage was grown on exclosures and members of the community had a right to cut a portion. The project helped poor farmers to buy sheep to fatten so that they could use their share of grass more profitably than selling it to others to fatten sheep.

A key informant working for ARARI[94] said that the project had helped the Bureau of Agriculture know how long exclosures need to be left before they can be sustainably used. He said that the paradigm shift was being scaled out through training being run by the Bureau of Agriculture. He also said that other organizations were pushing the idea of the sustainable use of exclosures, in turn responding to pressure from communities. He added that the contribution of the WLE-funded and ARARI-led project was to help ensure that the type, timing and intensity of income generating activities are indeed sustainable. Allowing communities to benefit from exclosures makes the technique more attractive, and more likely to be adopted.

IWMI/WLE will schedule a meeting with the Ministry of Water Resources (MoWR) to present the exclosure-use business models and the suitability mapping.[95] MoWR is interested in using exclosures to help protect watersheds above dams and other water supply and irrigation infrastructure.

Added value of WLE

This work, and the outcomes that are starting to flow from it, would not have happened without WLE initially funding a pilot project before funding a larger project. This work was fully funded by WLE, representing an investment of over US$ 1 million.[96]

Plausibility of the outcome claim

It is plausible that the WLE-funded projects have contributed to greater sustainable use of exclosures to the benefit of the communities upon whose land they sit. The work did not initiate the idea of using exclosures for economic benefit: the shift is happening anyway. However, the project has

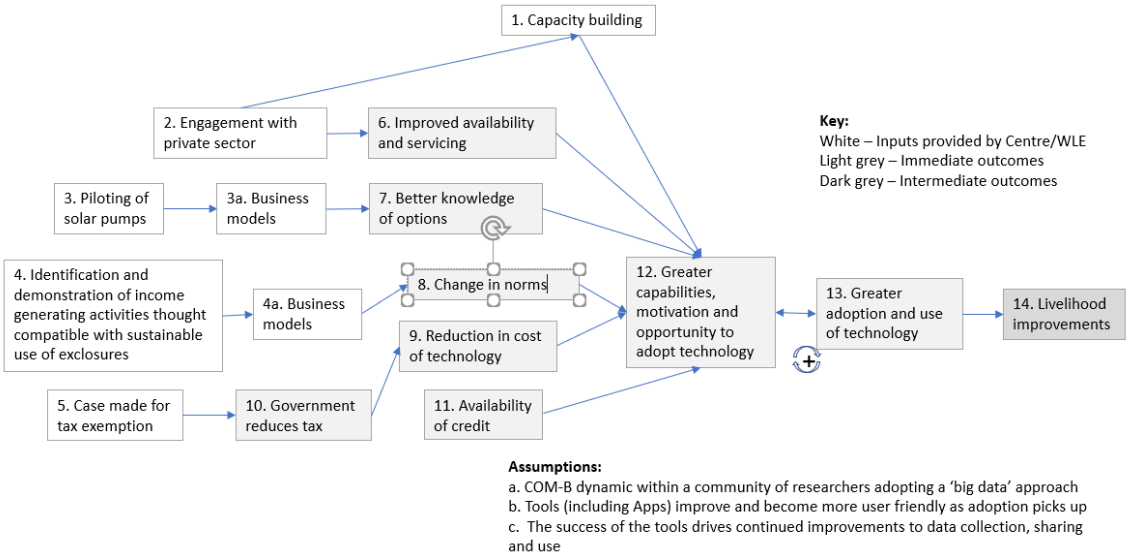
[94] Respondent 50
[95] Respondent 1
[96] Respondent 7

plausibly helped advance the process by providing analysis of different types of suitable livelihood activity and the generation of business model scenarios to help ensure sustainable use of exclosures. The project has placed emphasis on bringing benefit to women, youth and the landless.

Common theory of change underpinning the technology adoption outcome trajectories

Figure 7 shows the theory of change underpinning the three technology OTs. The numbers in the description of the theory of change below relate to the boxes shown in the model.

Figure 7: Causal model of how the technology adoption outcome trajectories are working



The causal model for Area of Change 3 is centered on strengthening capabilities, motivation and opportunities for rural people to adopt and benefit more from technologies that can improve livelihoods (box 12). The Area of Change includes two technologies: solar pumping and options for making economic use of exclosures. IWMI/WLE work has generated a number of enabling outcomes (boxes 6 to 11), including improved availability and servicing of solar pumps through engaging with a private sector supplier, reducing the cost of solar pumps through contributing to changes in tax on agricultural equipment, and changes in norms about what economic activities are allowable in exclosures.

Appendix 2. People interviewed and participants in the outcome evidencing workshop

Workshop participants

Name	Affiliation	Place of work	Outcome trajectory
Lulseged Desta#	CIAT	Addis Ababa	1A & 1B
Tesfaye Yackob	Jimma Agricultural Research Center	Jimma	1A & 1B
Meron Tadesse	CIAT Ethiopia	Addis Ababa	1A* & 1B
Hailu Terefe	Debre Berhanu University	Debre Berhanu	1B*
Tilahun Amede#	ICRISAT	Addis Ababa	1C
Asmare Dejen#	Wollo University	Dessie	1C*
Wolde Mekuria#	IWMI	Addis Ababa	3A, 3B & 3D*
Elvis Weullow	EthioSIS	Nairobi	2A*
Tegbaru Bellete	EthioSIS	Addis Ababa	2A
Mezegebu Getnet	ICRISAT Ethiopia	Addis Ababa	2B*
Degefie Tibebe	EIAR	Addis Ababa	2C*
Amare Haileslassie#	IWMI	Addis Ababa	3A*
Seyoum Getachew	IFAD	Addis Ababa	3A
Kassahun Teka	ATA	Addis Ababa	3B*
Birhanu Biazin Temesgen	ICRISAT Ethiopia	Addis Ababa	3B
Gebeyaw Tilahun	Woldya University	Woldiya	3C*
Belete Bantero#	MoA/ATA	Addis Ababa	3D*
Terefe Fitta	Consultant	Addis Ababa	Evaluation team
Boru Douthwaite	Selkie Consulting Ltd	Ireland	Evaluation team leader

Kindie Getnet	Independent consultant	Addis Ababa	Evaluation team
Keith Child	Impact Works Inc	Canada	Evaluation manager for WLE

Also interviewed

* Presenter

People interviewed

Name	Gender	Location of interview	Organization	Role
Dr. Tsegaye	M	Yewol (project site)	Wollo University	Lecturer & Focal person for the project
Sheh Ahmed Tadese	M	014 Dangu/ Yewol	Kebele	Chairman of the Kebele
Yimer Yesuf	M	014 Dangu/ Yewol	Kebele	Kabele Manager
Meseret Ahmed	F	014 Dangu/ Yewol	Kebele Agric. office	Dev't Agent in Natural Resources
Mesele Asefa	M	014 Dangu/ Yewol	Kebele Agric. office	Dev't Agent in Animal Production
Tilahun Kasa	M	014 Dangu/ Yewol	Local contractor	Construction worker
Mohamed Ali	M	014 Dangu/ Yewol	Local contractor	Construction worker
Abate Getahun	M	Dessie	WU	President, WU
Getachew Yimam	M	Dessie	Were-Ilu District Agric. Office	Senior expert
Workineh	M	Hosaina	Africa RISING	Site Coodinator
Mesfin	M	Hosaina	Interaid France	Project Officer
Eyuel	M	Hosaina	AR, IWMI, ICRISAT	Project Officer
Lapiso Girmiso	M	Doyo-Gena District	Lemi Suticho kebele	Eddir Secretary
Estifanos Yohannes	M	Kacha bira District	Burchana kebele	Member of Eddir
Yohaness Amado	M	Kacha bira District	Burchana kebele	Group peer educator
ALemu Kebede	M	Lemo District	Jewe Kebele	Member
Adnew Ayele	M	Lemo District	Jewe Kebele	Member
Tefera Anito	M	Lemo District	Upper Gana Kebele	Member
Bekelech Belachew	F	Lemo District	Jewe Kebele	Member
Teklu Erkossa	M	Addis Ababa	GIZ	Project manager
Kifle Woldearegay	M	Addis Ababa	Mekelle University	Mekelle University Lecturer
Mastewal Yami	F	Addis Ababa		Independent consultant

Christina Keller	F	Addis Ababa	GIZ	Project manager
Steffen Schultz	M		GIZ	Project manager

Appendix 3. Terms of Reference

INVITATION FOR EXPRESSIONS OF INTEREST FOR CONSULTANCY SERVICES TO CONDUCT AN EVALUATION OF SOIL AND WATER MANAGEMENT WORK CARRIED OUT IN ETHIOPIA UNDER THE CGIAR RESEARCH PROGRAM ON WATER, LAND AND ECOSYSTEMS (WLE)

Title of assignment: Evaluation of the work of the CGIAR Research Program on Water, Land and Ecosystems
(WLE) on soil and water management in Ethiopia

Date of commencement of consultancy: May 01, 2019.

Place of assignment: The consultant will be home-based, but will undertake travel to the project sites in
Ethiopia.

1. Summary

The CGIAR Research Program on Water, Land and Ecosystems (WLE) is seeking Expressions of Interest (EOI) from professional evaluator(s) to conduct an outcome evaluation of the program's research for development (R4D) work on soil and water management in Ethiopia.

Improving soil and water management practices has been a priority in Ethiopia since the 1970s. However, early efforts had limited success, owing to the various top-down approaches followed in implementing landscape restoration and water harvesting (LRWH) practices, a mismatch between LRWH options and what it takes to sustainably manage a landscape, inadequate monitoring and maintenance of LRWH schemes, and low adoption rates by communities who failed to realize the economic returns on their investments in LRWH projects.

Through its research, capacity strengthening and policy engagement since 2012, WLE has sought to make a positive contribution to improving soil and water management in Ethiopia. With a significant research investment in this body of work over a number of years, WLE now requires an evaluation to understand better what has worked through its R4D approach, for whom and why in specific contexts.

The objectives of the evaluation are the following:

1. To determine how and in what ways WLE contributed to the achievement of intended/unintended outcomes (see section *Evaluation Approach and Methods* below).

2. Based on findings of the evaluation, make recommendations on how WLE (and its partners) can become more effective in supporting soil and water management in Ethiopia.

3. To serve as a participatory learning experience for WLE and its partners.

2. Background

WLE is a global research-for-development program connecting partners to deliver agricultural solutions that sustain our natural resources – and the people who rely on them. The program is led by the International Water Management Institute (IWMI) and supported by CGIAR, a global research partnership for a food-secure future.

WLE brings together 11 CGIAR centers, the Food and Agriculture Organization of the United Nations (FAO), the RUAF Foundation, and national, regional and international partners to find integrated and sustainable solutions.

WLE is supporting a growing portfolio of policy and technical solutions across ecosystems, sectors and scales. These connect and consider key natural resources: land, water, biodiversity; and how to manage these to ensure we connect rural-urban environments, deliver gender equity, and manage risks and trade-offs. Capacity building cuts across many of our tools and approaches. WLE brings together constellations of projects led by different partners, and these are mapped to the program's flagships and outcomes. In this way, WLE plays more of an advisory role on top of partners' own strategies and project management. This constellation requires a sensitive investment of resources and approaches to achieve maximum value, and requires continuous reflection and evaluation.

WLE is actively pursuing partnerships with the private sector, universities and/or other research institutions to help conduct a number of (as many as six) *in itinere* and *ex-post* outcome evaluations over the next 3 years. By helping us better understand the complex mechanisms that lead to long-term impacts at scale, the purpose of the evaluations is to facilitate learning and demonstrate how WLE activities can add value to catalyze change.

3. General purpose of the evaluation

Through its work in Ethiopia, WLE ultimately hopes to make a positive contribution by helping to facilitate a better-informed agricultural policy and delivery environment that helps minimize or reverse land, water and forest degradation, and the associated negative impacts this has on livelihoods and economies. Initial evidence suggests that WLE activities have directly contributed to three policy-related outcomes:

1. In 2017, the Prime Minister of Ethiopia approved a policy to make all agricultural water technologies exempt from taxation.

2. Ethiopia adopted a new Soil Strategy to target soil fertility management interventions in various landscape niches.

3. The Sustainable Land Management Program (SLMP) began adopting new implementation interventions that target the community-led restoration of degraded landscapes.

Understanding better how research outputs combine with a set of political inputs to produce policy outcomes (e.g., what has changed, how and for whom) is the principal focus of the

evaluation (as opposed to the effectiveness of the specific technology packages that are employed or the policies influenced). To achieve this, the evaluation will examine the R4D that has taken place through WLE and its partners, their cumulative contribution to intended and unintended outcomes, the likely sustainability of these outcomes and the probability of these outcomes contributing to long-term impacts.

WLE carries out this work in Ethiopia through multiple flagships, although two flagships are crucial: Restoring Degraded Landscapes (RDL), and Land and Water Solutions for Sustainable Intensification (LWS). These flagships, in turn, work with a number of CGIAR centers, including IWMI, the International Center for Tropical Agriculture (CIAT), Bioversity International, and the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), along with other partners such as the Ministry of Agriculture (MoA), Ministry of Environment, Forestry and Climate Change (MoEFCC), Ministry of Water, Irrigation and Electricity (MoWIE), Ethiopian Institute of Agricultural Research (EIAR), Mekelle University, the Sustainable Land Management Program (SLMP), and the Agricultural Transformation Agency (ATA). A second core focus of the evaluation will, therefore, target how WLE working with these partners has managed synergies and contributed to accelerating their impact. What can WLE learn from its engagement with partners to improve R4D outcomes in the future?

4. Evaluation approach and methods

For this evaluation, 'Outcome Harvesting' (OH) is proposed as an evaluation approach. OH is inspired and informed by 'Outcome Mapping' and works backwards by examining the process by which change occurs, instead of the result or impact of the change: first, an outcome change is identified and then the specific contribution of WLE is determined. The general method will be adapted for this evaluation and may be combined with other approaches as needed.

WLE defines outcomes as observable changes in the behavior (actions, activities, relationships, policies or practices) of individuals, groups, organizations or institutions that are influenced in a small or large way, directly or indirectly, intentionally or not, by WLE research or activities. The three policy-related outcomes identified above will serve as a starting point for the evaluation. However, other positive/negative and immediate/intermediate outcomes are also likely (e.g., enhanced local research capacity).

WLE recognizes that different approaches may be appropriate, and encourages applicants to propose other innovative designs and methods. However, in conducting the evaluation, WLE wishes to employ a methodology(ies) that helps us to reduce overall cost and the duration of the evaluation process by avoiding the use of complex surveys administered to large sample sizes.

The applicant is expected to guide the design and management of the evaluation. The final approach, tools, methods, schedule, deliverables and budget will be determined in collaboration with the WLE Evaluation Manager. The applicant will provide quality assurance of the evaluation from beginning to end.

5. Draft evaluation questions

A complete list of evaluation questions will be developed in consultation with the evaluator(s) during the contracting stage. Potential questions include the following:

1. How and in what ways did WLE's support to its partners work on soil and water management contribute to intended outcomes?

1.1. Did WLE's knowledge products and engagement activities make a sufficient and appropriate contribution to observed outcomes? What alternative explanations exist for the achievement of these outcomes?

1.2. Were there any negative or unexpected outcomes across this body of work?

1.3. Did WLE help influence/contribute to the design and promotion of research that integrates/considers gender or the needs of marginalized groups within its partner centers?

2. Are outcomes likely to be sustainable over the long term?

2.1. How enduring is the influence of the research that has been funded through WLE and its CGIAR partners at the national and subnational levels?

2.2. Did WLE work with partners (research and development) who were appropriate to achieve its desired outcomes? How did the partnerships forged across WLE, CGIAR centers and Ethiopian partners contribute to the outcomes?

3. What lessons can be learned from this body of work to enhance the effective design, management and assessment of WLE R4D programs in the future?

3.1. How has WLE enhanced outcomes by bringing together the work of several CGIAR centers with a number of Ethiopian partners? Does WLE bring anything to this or would this have happened anyway?

3.2. How and in what ways did WLE's support influence decision-making processes within core partners and in specific geographical contexts?

3.3. Is there evidence to support the existence of positive feedback loops that may have led to a greater cumulative impact than the sum of WLE's individual activities? If so, how can WLE more effectively harness positive feedback loops to effect positive change in the future?

6. Evaluation outputs

The consultant(s) is expected to produce the following outputs:

- A scoping meeting(s) with WLE staff and partner centers to identify/confirm key outcomes of interest.

- An inception report in which the consultant(s) outlines the goals of the evaluation, potential impact pathways, the proposed evaluation approach, a work plan for conducting and finalizing the evaluation, a list of critical documents and people to contact, and a draft outline of the evaluation report. As we value quality and concision, the target length of the report will be agreed upon before writing the draft report and will be reviewed during the sense-making meeting.

- Based on a submitted draft report, a sense-making meeting with WLE management to discuss evaluative findings.

- A finalized evaluation report that answers the evaluation questions in sufficient quality and detail to be useful to WLE, and a stand-alone, five-page Executive Summary of the evaluation.

- Working with the WLE Communications Unit, a short blog to report the evaluation process and key findings.

7. Timing

The evaluation will commence as soon as possible after the applicant is selected. The evaluation is expected to be underway by May 01, 2019, at the latest.

8. Budget

The maximum total available budget for the assignment is USD 50,000.

9. The process

This request for EOI is to enable WLE to determine whether there are qualified evaluation providers with the skills and capabilities to complete the evaluation. WLE will select the most appropriate EOI for the task, based on skills, experience, proposed approach and budget as follows:

- Skills and experience of Lead Evaluator: 50%
- Proposed approach: 30%
- Budget: 20%

10. Expression of interest content

All applicants should provide a brief EOI, no more than four single-spaced pages, which includes the following information:

- Name of Principal Investigator(s).

- Postal address, legal registration and electronic contact information.

- Contact person (name, title, phone number, Skype ID, e-mail address).

- Experience with R4D outcome evaluations.

- Experience with CGIAR.

- The general approach and methods recommended to accomplish the overall purpose and objectives of the WLE outcome evaluation, including the number of days needed to complete the assignment.

- Daily rate and anticipated total budget

- Availability

- Contact information of three professional referees who may be contacted, if you are short-listed for the consultancy.

In addition to the EOI, applicants should provide a full curriculum vitae for the Principal Investigator(s).

Questions for clarification should be sent via email to:

Emma Greatrix, Program Manager, WLE, E.Greatrix@cgiar.org

Only short-listed applicants will be contacted. All costs and expenses related to the development of the four- page EOI are the responsibility of the applicant.

If an applicant's EOI is selected, WLE will contact the applicant to begin the design, budgeting and implementation planning for the evaluation.

11. Eligibility

Any experienced individual evaluator, consulting firm, or a combination of individuals and/or evaluation firms, whether for-profit, non-profit or academic institution.

The Lead Evaluator should have the following qualifications:

- Proven knowledge and experience in the evaluation of large, complex R4D programs.

- Experience in using mixed methods to answer evaluative questions.

- A particular strength in theory-based evaluation design.

- A record of publications related to R4D evaluation.

- A recognized evaluator in the field of evaluation.

- Experience of working in Africa.

12. Conflict of interest disclosure

All applicants should disclose all contractual or financial relationships with IWMI.

To apply, visit www.iwmi.org/jobs

EoI must be submitted by 23:30 GMT on March 27, 2019 (Wednesday).

Acknowledgements

This work was carried out under the CGIAR Research Program on Water, Land and Ecosystems (WLE) and supported by Funders contributing to the CGIAR Trust Fund, including Australian Centre for International Agricultural Research (ACIAR), United Kingdom: Department for International Development (DFID), The Netherlands: Directorate-General for International Cooperation (DGIS), Swiss Agency for Development Cooperation (SDC), and other partners found at wle.cgiar.org/donors. WLE is led by the International Water Management Institute (IWMI) with 12 other partners. Content may not reflect official opinions of these organizations.

The evaluation team would like to thank all those who contributed to this evaluation, conducted by Boru Douthwaite (team leader) and Kindie Getnet. The evaluation manager, Keith Child, guided the evaluation process and provided inputs and support to the evaluation team. Emma Greatrix provided financial and administrative information as needed. Dr. Amare Haileslassie and Rahel Mesganaw provided administrative and logistical support to the outcome evidencing workshop and evaluation field trips. The team particularly thanks the reviewers for fact checking and for their views and insights.