CGIAR Advisory Services

CGIAR Research Program 2020 Reviews: Water, Land and Ecosystems (WLE) Annexes

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Annex 1: Terms of Reference for the CRP2020 Review, Addendum

Links to CRP 2020 Reviews TOR and Addendum[1].

Annex 1.1: Call for Expressions of Interest

CRP 2020 Independent Reviews of Quality of Science and Effectiveness

Deliverables and consultation for the CRP Review (pag. 9–10 of the ToR attached)

The review team is expected to produce the following deliverables:

1. A preliminary findings matrix, for discussion midway through the review process, to check the progress of the review and to provide a basis for early course correction if required. The CAS Secretariat will provide the review team with a template for the preliminary findings matrix.
2. A brief presentation of preliminary findings, for the debrief with the CRP management and the CAS Secretariat for validation, factual corrections, and feedback.
3. A draft report of the CRP review, for review by the CRP management and the CAS Secretariat for final feedback. The CAS Secretariat will provide a template for the draft and final reports.
4. A final report of the CRP review, following the report template with a maximum of 20 pages, a 2-3 page executive summary, and a set of annexes with additional information apart from the main body of the report.
5. A PowerPoint presentation covering the main points of the review, including purpose, methods, findings, conclusions, recommendations and additional notes relevant to the review. The CAS Secretariat will provide a template for this presentation.

Templates for the preliminary findings matrix, draft and final report, and the presentations will be provided to the review team in the first week of the review.

The review team will engage with the CAS Secretariat and the CRP under review at the following key points:

- Initial discussion with the CAS Secretariat to start the review and clarify questions from the review team;
- Briefing at the start of the review between the review team and CRP management, facilitated by the CAS Secretariat;
- Interview with the CRP Leader and a focus group discussion (FGD) with other members of the CRP management during data collection;
- Debrief presentation of the preliminary findings led by the review team, for validation, clarifications and feedback by the CRP management and the CAS Secretariat;
- The draft report will be shared with the CRP Leader and staff for factual correction and final feedback.

Additional discussions between the review team, the CRP management and the CAS Secretariat may be scheduled based as needed during the course of the review.

[1] Accessed September 25, 2020

Annex 1.2: Addendum to the Terms of Reference & Call for Expressions of Interest, June 2020

The CAS Secretariat has made the following modifications to the Terms of Reference (TOR) and Call for Expressions of Interest, for the CRP 2020 Reviews of Quality of Science (QoS) and Effectiveness.

Please note: (i) the independent reviewers for CRP reviews that will begin in August (see Annex I for the working schedule) will be selected by the first week of July, and (ii) the overall deadline is 15 July 2020 for submission of expressions of interest for the CRP 2020 Review.

Methods. The proposed surveys of CRP researchers, partners and donors have been removed from the CRP 2020 Reviews. The sample frame of respondents for these surveys was considered to be smaller than anticipated, thereby limiting the value of quantitative data collected from the surveys. Given the extensive qualitative methods (primarily key informant interviews) already applied to the same pool of respondents, the value of the surveys was determined to be questionable. Further, the burden on respondents was considered excessive, and a higher value is placed on the in-depth qualitative interviews. Considering the limited value addition of the proposed surveys and the burden on respondents, CAS has removed the surveys as a method for the reviews.

Establishing contributions to Intermediate Development Outcomes (IDOs). Links between the outcomes (documented as milestones) from the CRPs and the CGIAR Strategic Results Framework will be examined at the sub-IDO level, not the IDOs themselves.

Data sources. CRP performance data will be drawn from the Plans of Work and Budget (POWBs) and Annual Reports for the period under review, with supplementary information from the CGIAR result dashboard. The CAS Secretariat supports the reviews by integrating data from the dashboard, the CRP internal monitoring, and the POWB and annual reports, to allow the review team to make quantitative assessments of performance. The dashboard data will also be used in conducting a 'deep dive' of selected CRP outcomes (OICRs).

Knowledge management. The review team will be responsible for uploading and storing its original data, analysis and drafts on the secure online content site (SharePoint) provided by the CAS Secretariat, as a basic step in knowledge management for the review.

Analytics support. The team will also need to adhere to timelines for accessing technical consultants made available by the CAS Secretariat, e.g., for quantitative analysis of performance data.

Distribution of effort within team. The two members of each review team (subject matter expert and senior evaluator) are each allocated 39 days for execution of the work, over the 11-week period. An additional two days are allocated to the team member who takes on the team leadership role. The team leader will also commit to responding to any questions or need for clarifications that arise from copy editing of the final report.

Further notes to interested consultants:

Consultants who have already submitted their expressions of interest have been logged in the CAS consultant database and do not need to re-submit their documents. Short-listed candidates will be contacted as preparations for the CRP reviews are made.

Consultants who wish to apply should indicate their expertise and availability in relation to the nine CRPs that are scheduled to be reviewed between August and December 2020. The reviews of three CRPs (A4NH, GLDC and Wheat) have already started.

Working schedule of CRP 2020 reviews

CGIAR Research Program (CRP)	Type	Review period
Grain, Legumes and Dryland Cereals (GLDC)	Agri-Food System	Apr-Jun
Wheat	Agri-Food System	Apr-Jun
Agriculture for Nutrition and Health (A4NH)	Global Integrated Program	Apr-Jun
Forests, Trees and Agroforestry (FTA)	Agri-Food System	Aug-Oct
Livestock	Agri-Food System	Aug-Oct
Climate Change, Agriculture and Food Security	Global Integrated Program	Aug-Oct
Fish	Agri-Food System	Sep-Nov
Maize	Agri-Food System	Sep-Nov
Water, Land and Ecosystems (WLE)	Global Integrated Program	Sep-Nov
Rice	Agri-Food System	Sep-Dec
Roots, Tubers and Bananas (RTB)	Agri-Food System	Sep-Dec
Policies, Institutions and Markets (PIM)	Global Integrated Program	Sep-Dec

Note: this working schedule may be modified. When submitting an Expression of Interest, consultants are advised to indicate a range of dates for which they are available for conducting the reviews. The schedule for all 12 reviews spans April to December 2020, with an anticipated during of 11 weeks for each review. The final three reviews will begin in late September, to conclude by mid-December.

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Annex 2: CRP Specific Methodology

2.1: Scope

The review spans the work of the WLE undertaken through the five FPs and supported by the programme management unit from 2017–2019. The review has focused on two evaluation criteria: Quality of science, and effectiveness, and was guided by the CGIAR's quality of science and effectiveness criteria and by the results frameworks and theories of change set out for the WLE and its FPs.

For quality of science, the reviewers have focused on:

- **Credibility** - Accuracy; appropriateness of methods; suitable interpretation; good science practice, including peer review
- **Legitimacy** - Ethical and fair representation of all involved, implementation of ethics guidelines, consideration of interests and perspectives of intended users, transparency/lack of conflict of interest, recognition of responsibilities, recognition of partners' contributions, partnerships built on trust and how gender, youth and marginalized groups are included in research design and production
- **Research Inputs** - Staff and capacities, team composition, infrastructure availability, funding sources and distribution of funding
- **Research processes** - Incentives for achieving and maintaining the high scientific credibility of outputs, effectiveness of organizational management systems to promote quality research
- **Research outputs** - Quality and quantum of research and technical publications using bibliometric analysis carried out by CAS; deeper review of selected research publications highlighted in the CRP Annual Reports, considering number of citations, looking at H indices, journal impact factor, Altmetrics score and author profiles.

For effectiveness, the reviewers have looked at:

- **Performance** including delivery of planned milestones, outputs and outcomes set out in annual planning processes
- **Coherence of annual planning processes** with respect to the program theories of change
- **Contribution** to higher level outcomes and to cross cutting issues
- The implications of extended **timeframes** for achieving results in the WLE context
- Support and guidance provided by **program management and governance** including the capacity to address risks and emerging issues and to learn and adapt the research portfolio in response to results
- Evidence of and **potential for further progression along impact pathway** set out in the WLE and FP ToCs.

Emphasis has been placed on the CRP's sphere of control, namely, the quality of inputs, activities and outputs, and influence. To the extent feasible, the review of effectiveness will assess the likelihood of delivering the WLE expected contributions to Intermediate Development Outcomes (IDOs) and/or sub-IDOs and of further progression along the impact pathways set out in the ToCs.

The review period represents the first three years of the planned six-year program (now reduced to 5 years). It is not expected that all planned outcomes will have been achieved at this time.

2.2: Review Questions

The Review addresses three main evaluation questions (EQs) as set out in the evaluation terms of reference (Annex 1) and in the CRP Review Guidelines[2]. Each of the EQs is supported by a series of sub-questions. The CRP has not yet identified any further key questions during the inception meetings.

Quality of Science: To what extent does the CRP deliver Quality of Science, based on its work from 2017 through 2019?

- How adequate are the inputs that are necessary to deliver planned outputs and outcomes?

[2] CRP 2020 Review Guidelines, 28 Sept 2020

- How good are the CRP management processes to ensure the quality of science, including relevance to next stage users, scientific credibility and legitimacy, of the research and operations?
- How high is the quality of research outputs (germplasm, knowledge tools and publications)?
- Overall: Is the CRP delivering the science that it said it would deliver?

Effectiveness: What outputs and outcomes have been achieved and what is the importance of those identified results?

- To what extent has the program delivered and contributed to the programs expected immediate and longer term expected results (milestones, targets, and sub IDOs) and to cross cutting issues?
- How well have the program ToCs supported learning and adaptation?
- How well do management and government processes support program planning, delivery and reporting as a foundation for longer term outcomes, ensuring accountability and enabling learning and adaptation?

Future Orientation: To what extent is the CRP positioned to be effective in the future, seen from the perspectives of scientists and of the end users of agricultural research (such as policymakers, practitioners or market actors)?

- What are the prospects for future effectiveness of WLE up until 2021?
- What is the potential future contribution of the program's deliverables?
- Evidence of good practices in research management and/or governance, linked to the transition to One CGIAR.
- Which research lines hold promise for future innovation and impact?

2.3: Methodological Approach

Mixed methods were used to enable triangulation by combining empirical analysis (where available) and deductive inference. The focal unit of analysis were the Flagship Programmes, assessing the extent to which they have delivered their milestones and met their targeted outcomes as described or committed in the project document, annual programmes of work and budgets and ToCs.

To inform this analysis, information and data sources included:

- To sketch the *bigger picture*, the various theories of change, outcomes, IDOs and impact pathways were synthesized to present an integrated picture of the strategic direction of the programme, and what it aims to achieve.
- To understand *inputs* affecting research quality: Interrogation of the CRP structure and its FPs and research themes, staff profiles (including H indices), information on research funding (Windows 1–3) and bilateral funding. This was supplemented by focus group discussions with FP leadership and selected scientists to find out what they think about resources, partnerships, incentives, and their perspectives of the key factors affecting most significant research outputs.
- To understand *quality* of outputs: We used bibliometric and Altmetric analysis provided by CAS; annual reports (2017–19) with their tables and narrative on publications, innovations and policies; communication materials related to research findings; and interviews with CRP leadership, partners, and users of research (including donors). The criteria outlined in the QoR4D guidelines were used as a basis for assessing the top publications with high Altmetric scores cited more than 10 times.
- To understand *processes* affecting research quality: Policies and processes for QA of science (ethics, peer review systems, COI, program design processes); MARLO data on innovations (especially those in advanced stages), capacity development, and co-authorship and partnerships. This was supplemented CGIAR briefs, handbooks, and interviews with CRP leadership and management team and FP leadership.
- To understand *effectiveness*, including contribution to the WLE results framework, contribution to cross cutting issues (gender, youth, capacity development, climate change), and potential for progression along ToC impact pathways: OICRs, MARLO data on effectiveness including

innovations and policies, interviews with CRP leadership management team (including FP leaders), clients and users of research. Findings in this area are elaborated in Annexes 8, 9 & 10.

- To understand the *processes affecting alignment and contribution* to the WLE results framework and cross cutting issues and supporting progression along impact pathways: Documented management systems and processes, interviews with CRP leadership and management team.
- To assess to what extent research approaches, methods and outputs exemplify an *integrated systems approach* – and how they are reflecting the cross-cutting themes and 'big issues' such as gender and youth development, capacity development, climate change, and drivers of ecosystem change and good quality of life: Interpretation of selected publications, research outreach materials and communications; POWBs; OICRs; key informant interviews and WLE web site.

The report sections are interrelated. The team has explored how science is designed and delivered (with specific reference to credibility, legitimacy and user engagement) to serve as a driver for outcomes and ultimately impacts, including with reference to assumptions set out in the WLE and FP ToCs. The latter are particularly important in view of the (typically) long-term nature of WLE outcomes and impacts. At a practical level the evaluation explored how resource planning processes affect inputs (linking EQ 1.1 and 2.3), including with regard to timeliness of inputs.

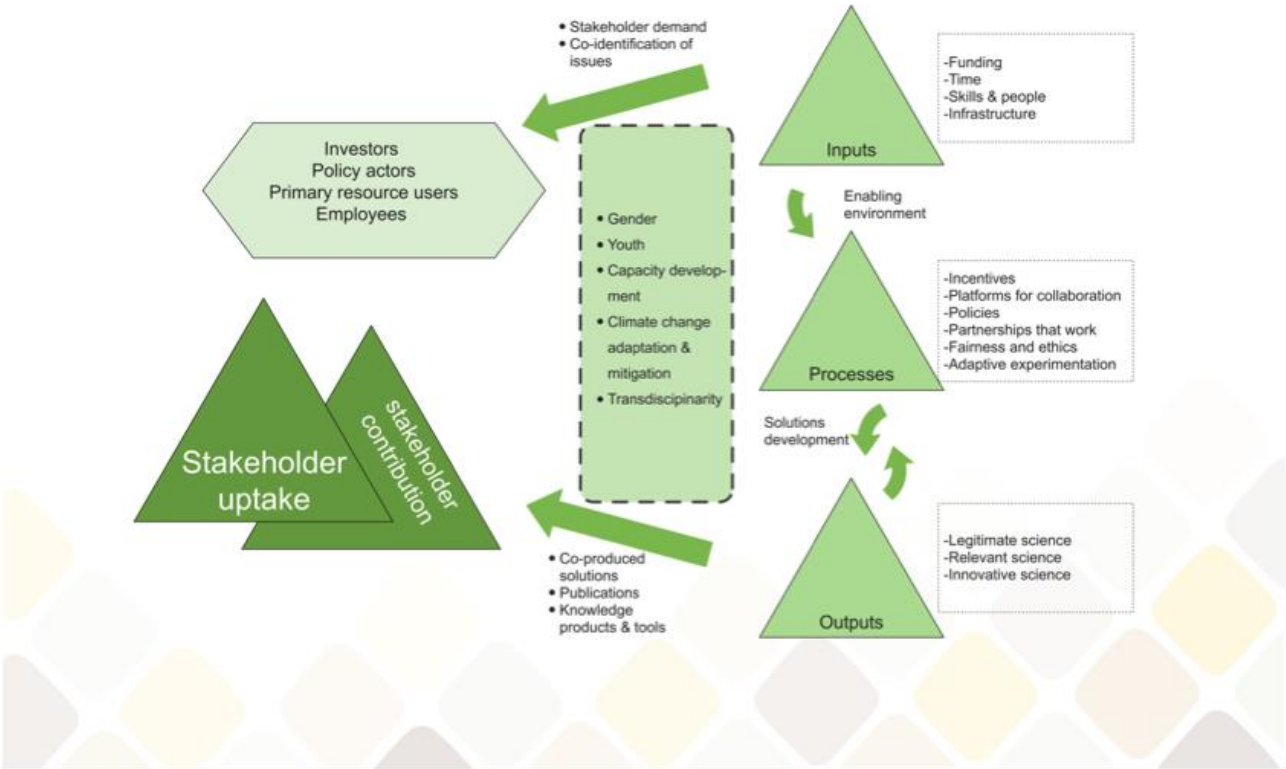
2.4: Data Collection

The team used the full range of methods set out in the CRP 2020 review guidelines (literature and data review, semi-structured interviews, OICR deep-dives) and related evaluation matrix, building on the review of key documents as summarized in Annex 3.

Quantitative Data – Quality of Science

The conceptual framework in Figure 1 provided a 'lens' through which to look at WLE's quality of science. It explains how inputs, processes and outputs influence one another, and the important role of stakeholders in identifying problems, co-creating solutions and ultimately resulting in stakeholder uptake. Gender, youth, climate change, and trans-disciplinarity are mediating factors that connect the demand for and creation of solutions, knowledge and tools.

Figure 1. A framework to conceptualize the flows, pathways and feedbacks from inputs, processes, outputs and stakeholder uptake of WLE's work



The approach to evaluate Quality of Science resonates with CGIAR's QoR4D framework (cf. https://cas.cgiar.org/sites/default/files/pdf/ispc_brief_62_qord.pdf). *Scientific credibility* is covered in the science inputs evaluated (research teams, funding and infrastructure) as well as the processes (partnerships, internal review mechanisms) and the outputs (publications; physical products; and communication of research findings. *Legitimacy* is covered in the science processes (partnerships; ethics; internal review mechanisms; mentoring of junior staff) as well as all aspects of the science outputs. For inputs, the bibliometrics database provided by CAS, the CGSPACE online database and WLE Thrive blog provided valuable information on researcher track records such as H Indices and number of papers produced. Data from IFPRI's ASTI project was useful to assess gender ratios in centers, and the internet as well as the searchable CGIAR expertise database was used to access staff qualifications and individual collaborations. Programmes of Budget and Work and Annual Reports were used to obtain data on financial and infrastructure inputs. These sources were supplemented with interviews and OICR analyses.

For processes, we extracted information from annual reports, policy documents generously provided by CAS and sourced from the CGIAR website. This information was verified through focus group discussions and discussions with individual researchers involved in the analyzed OICRs.

Four outputs, the bibliometrics database provided valuable information about journal impact factors, number of articles produced and by who, and citations. Altmetric data was useful to assess science uptake and dissemination. For the more detailed analysis of papers mentioned in Annual Reports with high Altmetric scores (>100), the online journal sites provided valuable information about more up to date citations and Altmetrics.

Quantitative Data – Effectiveness

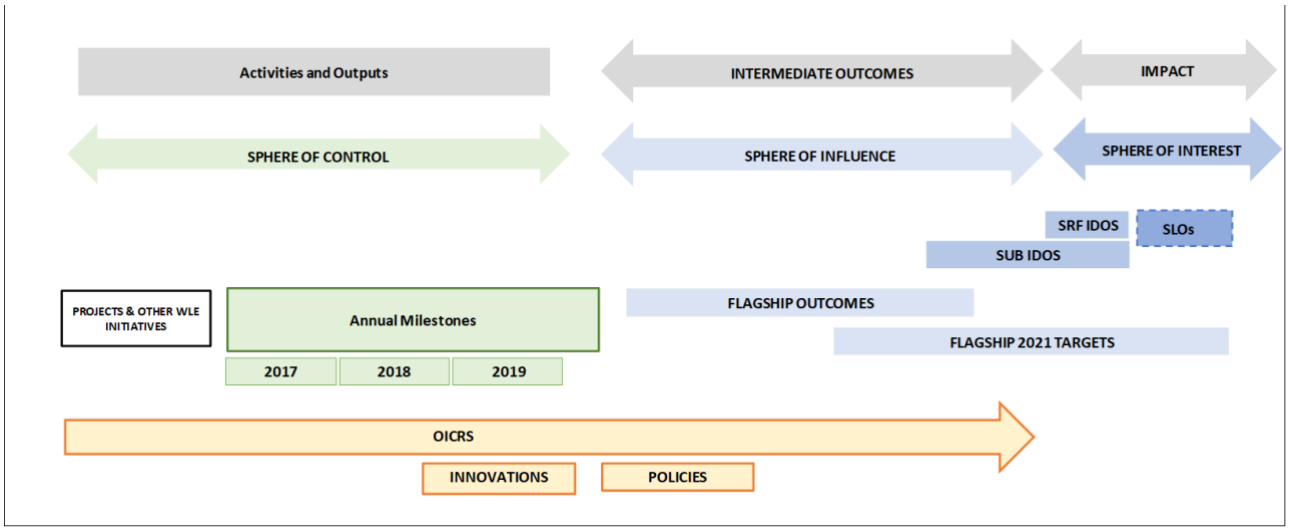
The WLE Results Framework includes flagship outcomes and indicators which contribute to the system level IDOs (and sub-IDOs) and system level outcomes (SLOs) and/or to the cross-cutting initiative IDOs (and sub IDOs). The higher-level outcomes are set out in the CGIAR Strategic Results Framework (SRF) (Annex 9).

Figure 2 shows the hierarchy of results and indicates reporting undertaken by WLE. The outlined boxes in Figure 2 indicate that there is regular or systematic reporting on this element. Systematic year on year

reporting against milestones set out in the annual programme of work and budget (POWB) is recorded in Annual Reports and in the CGIAR tracking system (MARLO) that was adopted by WLE in 2018. A summary of data on milestones in provided in Annex 7.

Reporting on projects is undertaken at the center level in line with donor requirements. Highlights and lessons from WLE mapped projects and other WLE initiatives are reported in WLE Annual reports.

Figure 2. WLE Reporting Relative in the Context of the WLE and CGIAR SRFs



WLE collates data on policies and innovations annually, and reports it in MARLO on the WLE dashboard (Annex 7). Researchers are encouraged to develop OICRs on initiatives which have well documented and evidenced outcomes including those related to policy. There is no benchmark or target for reporting on OICRs, innovations or policies and this data is considered by the review to be anecdotal in nature.

The majority of the data on effectiveness was extracted by the CAS Secretariat Technical Analyst from MARLO. CAS analyzed the CRP deliverables, outcomes, milestones, flagships, and timing.

Quantative data related to partnerships, capacity development and contribution to SLOs was extracted from the CGIAR Results Dashboard. Additional quantitative data is available in the WLE Annual reports for 2017 to 2019, however the format for data presentation varies from year to year and does not always allow trend analyses. Quantitative data has been triangulated with qualitative data.

Qualitative Data

Qualitative information on OICRs, policies and innovation is available in the WLE dashboard and has been supplemented by other publically WLE available sources including annual reports and the website, including the notably the Thrive section of the WLE website. Qualitative data on delivery of milestones, including consideration of anticipated risks, was taken from the WLE annual reports. The 2016 Annual report was used to provide a historical perspective on the evolution of selected initiatives (notably those addressed in OICRs).

A full list of references is included as Annex 3.

The review team conducted 23 semi-structured interviews reaching 34 people (Annexes 4 and 5). An open round table format was used for group interviews with groups of FP leaders.

Use of OICRs

The WLE has published 20 OICRs on the CGIAR Dashbaord. The reviewers undertook three deep-dive studies into three selected OICRs bringing together qualitative and quantitative data. OICRs that were identified to i) be representative of the work being delivered across the WLE FPs, while avoiding overlap between lead centers; ii) to include cases with details on the full timeline of activities and outputs leading to outcomes and impacts, including sequential cases to the extent that these were available; iii) to avoid overlap with other outcome studies and evaluations covering the review period, including notably the Ethiopia Outcome Evaluation.

The OICRs are subject to internal quality control including verification of evidence presented and are considered as reliable sources of evidence. The analyses are based on available documented information as well as interviews with FP leaders, research group leaders, and a sample of stakeholders to bring in the perspectives of beneficiaries, national and international research partners, donors, and other uptake partners. Findings have been documented using the template provided for the evaluation (Annex 9).

The reviewers also undertake a horizontal study on impact pathways, timing and consideration of cross cutting issues across all OICRs. To the extent possible the reviewers will:

- Typify and map interventions amongst the relevant FP and WLE impact pathways
- Consider the timeframe of the intervention and progression along the impact pathway based on reference to earlier events and outputs. For example, the 2016 annual report indicates that many of the topics and outcomes documented in the OICRs were subject to earlier work in the WLE Phase I
- Enrich the analysis of cross cutting themes (Gender, Youth, Capacity Development and Climate Change) by drawing on cases where these are identified as significant issues in the OICR summary.

2.5: Limitations

The CRP review has been limited by the following factors related to the evaluation process, scope and data availability.

- The review is desk based using on a set of documents and data prepared by CAS and by the CRP covering the period 2017–2019, supplemented by interviews and data in the public domain.
- The review took place over a short timeframe (29 September 2020 - 15 December 2020), and the reviewers faced some limitations in scheduling of interviews.
- The review does not extend to level of individual projects falling under the umbrella of WLE but delivered through participating centers and partners.
- The review has taken only a limited perspective on institutional arrangements.
- The period covered by the review (2017–19) is short relative to the time frame for bringing about change in often complex and multi-dimensional environmental interventions addressed by the WLE.
- The effectiveness data available to evaluators is largely based on success stories (OICRs, innovations and polices) and on milestones that are developed during annual planning. This generates a risk of i) a bias towards positive cases that are fully aligned with the WLE results framework and ii) a risk of failing to recognize a large volume of work that falls below the reporting threshold since a) it has not yet reached maturity or b) it is not well aligned with the results framework. This presents a limitation with regard both assessing effectiveness and learning.

Annex 3: List of Documents Reviewed

CGIAR Reports

CGIAR (2018). CGIAR System 3-Year Business Plan (2019–2021) Companion Document Developing an action plan on shared services: a discussion paper (Issue November 2018).

CGIAR (2018). CGIAR System 3-Year Business Plan (2019–2021) Companion Document Attract additional funding in support of Center Alliances (Issue October 2018).

CGIAR. (2018). 3-Year System Business Plan Companion Document: Action 4: Strengthen program performance management.

CGIAR ISDC. (2020). Quality of Research for Development in the CGIAR Context.

CGIAR-IEA. (2016). Evaluation of Capacity Development Activities of CGIAR: Vol. I (Issue June). http://iea.cgiar.org/

CGIAR. (2016). CGIAR Strategy and Results Framework 2016-2030: Overview.

WLE Reports

Project document & ISPC Review

WLE (2016) WLE CRP and FP Narratives Proposal 2017–2022

ISPC Assessment of the Water, Land and Ecosystems (WLE) CRP II revised proposal (2017–2022) – September 2016

WLE (2017) Amended Flagship 5: Enhancing Sustainability across Agricultural Systems (ESA) – July 2017

Programmes of Work and Budget

WLE (2017). 2017 Plan of Work and Budget (POWB): CGIAR Research Program on Water Land and Ecosystems (WLE). CGIAR Research Program on Water, Land and Ecosystems. https://cgspace.cgiar.org/handle/10568/92459

WLE (2018). CGIAR Research Program on Water, Land and Ecosystems - Plan of Work and Budget 2018. https://hdl.handle.net/10568/92412

WLE (2019). Plan of Work and Budget 2019 (POWB) CGIAR Research Program on Water, Land and Ecosystems (WLE). CGIAR Research Program on Water, Land and Ecosystems. https://cgspace.cgiar.org/handle/10568/105686

Annual Reporting

WLE (2017). 2016 Annual Report: CGIAR Research Program on Water, Land and Ecosystems (WLE)

WLE (2018). 2017 Annual Report: CGIAR Research Program on Water Land and Ecosystems (WLE) (Issue March).

WLE (2019). 2018 Annual Report: CGIAR Research Program on Water Land and Ecosystems (WLE) (Issue July).

WLE (2020). 2019 Annual Report: CGIAR Research Program on Water, Land and Ecosystems (WLE) (Issue May).

Other WLE documents (Selected)

WLE Results Framework/Phase II 2017–2021 Impact Pathway April 2020

WLE OICR Reports from the CGIAR Dashboard (PDFs, 20 files)

WLE (2018). Solutions for Thriving Ecosystems: 2017–2018 Research Highlights. CGIAR Research Program on Water, Land and Ecosystems. https://hdl.handle.net/10568/93010

WLE (2020). Soil-plant spectral technology guiding soil fertility investments in Africa (WLE-ICRAF) (Vol. 14).

WLE (2019) Outcome Evaluation of the work of the CGIAR Research Program on Land, Water and Ecosystems (WLE) on soil and water management in Ethiopia & Management Response

WLE (2019) Outcome evaluation of research for development work conducted in Ghana and Sri Lanka under the Resource, Recovery and Reuse (RRR) subprogram of the CGIAR Research Program on Water, Land and Ecosystems (WLE) & Management Response

WLE (2020) Gender and Inclusion Reviews by Flagship Program

WLE Minutes of meetings of the WLE Independent Steering Committee (ISC)

WLE Miscellaneous Internal Documents (Project lists, Example of Programme Partnership Agreement, 2019 and addendum; Planning: Principles, Process and Criteria for Inclusion, Process for approving bilateral grants, awarded after issuance of annual Program Partnership Agreement (PPA) project lists, September 2019; 2019 POWB FP Meeting Minutes)

CGIAR Dashboards https://www.cgiar.org/dashboards/

WLE Website https://wle.cgiar.org/

WLE Publications

Amerasinghe, P. H., & Dey, D. (2018). Recommendations for the wise use of urban and peri-urban wetlands in Kolkata, India. CGIAR Research Program on Water, Land and Ecosystems. https://hdl.handle.net/10568/96987

Anderson, E. P., Jackson, S., Tharme, R. E., Douglas, M., Flotemersch, J. E., Zwarteveen, M., Lokgariwar, C., Montoya, M., Wali, A., Tipa, G. T., Jardine, T. D., Olden, J. D., Cheng, L., Conallin, J., Cosens, B., Dickens, C., Garrick, D., Groenfeldt, D., Kabogo, J., … Arthington, A. H. (2019). Understanding rivers and their social relations: A critical step to advance environmental water management. Wiley Interdisciplinary Reviews-Water, 6(6). https://doi.org/10.1002/wat2.1381

Aynekulu, E., Lohbeck, M., Nijbroek, R. P., Ordoñez, J. C., Turner, K. G., Vågen, T.-G., & Winowiecki, L. A. (2017). Review of Methodologies for Land Degradation Neutrality Baselines: Sub-National case studies from Costa Rica and Namibia. https://hdl.handle.net/10568/80563

Beintema, N. M. (2020). Evolution of CGIAR funding. Intl Food Policy Res Inst.

Butler, B. M., Sila, A. M., Shepherd, K. D., Nyambura, M., Gilmore, C. J., Kourkoumelis, N., & Hillier, S. (2019). Pre-treatment of soil X-ray powder diffraction data for cluster analysis. GEODERMA, 337, 413–424. https://doi.org/10.1016/j.geoderma.2018.09.044

Byman, D., Lesser, I. O., Pirnie, B. R., Benard, C., & Waxman, M. (2018). Strengthening the Partnership, creating impact. CGIAR 3-year business plan 2019-2021 (Issue November).

Cai, Y., Guan, K., Lobell, D., Potgieter, A. B., Wang, S., Peng, J., Xu, T., Asseng, S., Zhang, Y., You, L., & Peng, B. (2019). Integrating satellite and climate data to predict wheat yield in Australia using machine learning approaches. AGRICULTURAL AND FOREST METEOROLOGY, 274, 144–159. https://doi.org/10.1016/j.agrformet.2019.03.010

Cuthbert, M. O., Taylor, R. G., Favreau, G., Todd, M. C., Shamsudduha, M., Villholth, K. G., MacDonald, A. M., Scanlon, B. R., Kotchoni, D. O. V., Vouillamoz, J.-M., Lawson, F. M. A., Adjomayi, P. A., Kashaigili, J., Seddon, D., Sorensen, J. P. R., Ebrahim, G. Y., Owor, M., Nyenje, P. M., Nazoumou, Y., … Kukuric, N. (2019). Observed controls on resilience of groundwater to climate variability in sub-Saharan Africa. NATURE, 572(7768), 230+. https://doi.org/10.1038/s41586-019-1441-7

Dinesh, D., Campbell, B. M., Bonilla Findji, O., & Richards, M. (2017). 10 best bet innovations for adaptation in agriculture: A supplement to the UNFCCC NAP Technical Guidelines. https://hdl.handle.net/10568/89192

Findings, S., & Questions, R. (2020). CRP 2020 Reviews : Agriculture for Nutrition and Health. 02(02), 2019–2020.

Garrick, D., De Stefano, L., Yu, W., Jorgensen, I., O'Donnell, E., Turley, L., Aguilar-Barajas, I., Dai, X., Leao, R. de S., Punjabi, B., Schreiner, B., Svensson, J., & Wight, C. (2019). Rural water for thirsty cities: a systematic review of water reallocation from rural to urban regions. Environmental Research Letters, 14(4). https://doi.org/10.1088/1748-9326/ab0db7

Gleeson, T. (2019). Groundwater: a call to action. Nature, 576(7786), 213.

Gourlay, S., Aynekulu, E., Carletto, C., & Shepherd, K. (2017). Spectral Soil Analysis Household Surveys: A Guidebook for Integration. https://hdl.handle.net/10568/99331

Grafton, R. Q., Williams, J., Perry, C. J., Molle, F., Ringler, C., Steduto, P., Udall, B., Wheeler, S. A., Wang, Y., Garrick, D., & Allen, R. G. (2018). The paradox of irrigation efficiency. Science, 361(6404), 748–750. https://doi.org/10.1126/science.aat9314

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Annex 4: List of Persons Interviewed

The reviewers conducted 24 individual and group interviews reaching 34 people, 17 female (50 %) and 17 males. Three interviewees (in addition to PMU members) were involved in more than one meeting.

Several members of the WLE Management Committee group took part in a presentation and discussion of preliminary funding.

PIM link	Name	Role	Institution	F/M	Location
Program Management Unit (PMU)	1. Izabella Koziell	WLE Director, MC Chair	IMWI	F	Sri Lanka (Currently France)
	2. Emma Greatrix	Head of Program Management, MC	IMWI	F	USA
	3. Keith Child	Interim Monitoring & Evaluation Lead	IMWI	M	Canada
	4. Deepa Joshi	Gender, Youth and Inclusion Lead, MC	IMWI	F	Sri Lanka
	5. Niroshina Fernando	Communication and Knowledge Management Specialist, MC	IMWI	F	Sri Lanka
Independent Steering Committee (ISC):	6. Ann Tutwiler	Chair	NA	F	USA
	7. Diane Holdorf	Member	WBCSD	F	Switzerland
	8. Mark Smith	Member & IMWI Director	IMWI	M	Sri Lanka
	9. Johan Rockström	Former Chair to March 2019	Potsdam Institute for Climate Impact Research	M	Germany
Funding partners – WLE (W1/2):	10. Eva Ohlsson	Representative	SIDA	F	Sweden
	11. Johanna Palmberg	Representative	SIDA	F	Sweden
Funding Partners – Projects (W3/Bilateral)	12. Robyn Jonhston	Representative	ACIAR	F	Australia
Center Funding	13. S.K. Chaudhari	Representative	ICAR	M	India
	14. Leigh Winowiecki	FP1 – RDL, MC	ICRAF	F	Kenya
Flagship Leaders:	15. Marcela Quintero	FP1 – RDL, MC	CIAT	F	Colombia
	16. Anthony Whitbread	FP2 – LWS, MC	ICRISAT	M	Tanzania
	17. Stefan Uhlenbrook	FP2 – LWS, MC	IWMI	M	Sri Lanka
	18. Jennie Barron	Former FP2	Swedish University of Agricultural Sciences	F	Sweden
	19. Pay Drechsel	FP3 – RUL, MC	IWMI	M	Sri Lanka
	20. René van Veenhuizen	FP3 – RUL, MC	RUAF	M	Netherlands
	21. Matthew McCartney	FP4 – VCR, MC	IWMI	M	Sri Lanka
	22. Claudia Ringler	FP4 – VCR, MC	IFPRI	F	Canada
	23. Roseline Remans	FP5 – ESA, MC	Bioversity	F	Switzerland
	24. Natalia Estrada Carmona	FP5 – ESA	Bioversity	F	Italy
	25. Daniel McGonigle	Former FP5	DEFRA	M	UK

PIM link	Name	Role	Institution	F/M	Location
Participating Centers	26. Fabrice DeClerq	Former Center Director, Bioversity	Alliance of Bioversity and CIAT	M	France
	27. Ermias Betemariam	Senior Scientist	ICRAF	M	Kenya
	28. Andrew Sila	Senior Scientist	ICRAF	M	Kenya
	29. Andre van Rooyen	Senior Scientist	ICRISAT	M	Zimbabwe
	30. Martin Moyo	Senior Scientist	ICRISAT	M	Zimbabwe
	31. Giriraj Amarnath	Senior Scientist	IMWI	M	Sri Lanka
	32. Philippa Cohen	Flagship Lead Fish CRP	Worldfish	F	Australia
Others	33. Ruben Echeverría	Chair, CoSAI	IFPRI	M	USA
	34. Sonja Vermeulen	Director of Programs	CGIAR System	F	France
			Total: 34	**17 F** **17 M**	

MC – Member of Management Committee

Annex 5: Data Collection Tools

1. Scope of FP Interviews

> Planning processes including design of the FP and annual programming

Design of the FP, opportunities and constraints

Results-framework: How are annual milestones developed in the context of expected contributions to higher-level results

Contribution to cross cutting issues

How decisions about geographic priorities and geographic spread of research themes are informed

> Resource allocation processes and programme alignment

Adequacy and timing of resources

Processes adopted to ensure fairness and equitability in a) prioritizing allocation of W1 research funding to Centers and FP's and b) approving acceptance of W3 and bilateral research funding and c) sharing research staff, equipment and infrastructure across centers

> Processes for ensuring science quality

Internal peer review and feedback processes related to science outputs

Incentives for researchers to produce quality science – tangible and intangible

Approaches being used to promote robust multi-stakeholder research partnerships

How science capacity development programmes are prioritized, monitored and adapted

> Monitoring and reporting on delivery

Results framework – beyond milestones

Criteria for assessing innovation

Choice of OICR for a 'deep dive' review

How to consider other examples of success that may not have reached the maturity or evidence requirements to be developed as OICRs

> Adaptive management including use of the theory of change

Use and adaptation of the theory of change (> leading into drivers, assumptions, timeframes, etc.)

How theories of change are linked to / feed into research prioritization

> Future perspectives

Promising areas of future research; how future's thinking tools e.g. horizon scanning and scenario planning are being used

A mind-map (Figure 2) was used to guide the flow of questions and direct conversations about quality of science in the initial stages.

2. FP Questions

How adequate are the research inputs (funding, skills, infrastructure), to deliver relevant high-quality science? Which are most valuable? Where are areas for improvement

Which WLE systems and processes are most valuable - to ensure relevant, good and credible science in the context of expected results? Where are areas for improvement?

What are the FP's top research outputs – e.g. publications and products? What are your reasons for rating them highly?

How do you establish your annual milestones and how useful are these for capturing i) the full scope of work across the WLE portfolio and ii) tracking progress toward higher level results (FP targets and outcomes, and at the system level, sub-IDOs)?

How do you use the theory of change and how useful has it been as a strategic tool at programme level?

Are there internal databases or reports, not yet shared with us, which could help us to assess research quality and effectiveness?

What would you say is the greatest obstacle to the FP, or WLE, meeting its planned outcomes?

What could be WLE's most important future contribution to CGIAR, looking forward?

Anything else you would like to share with us or point us to?

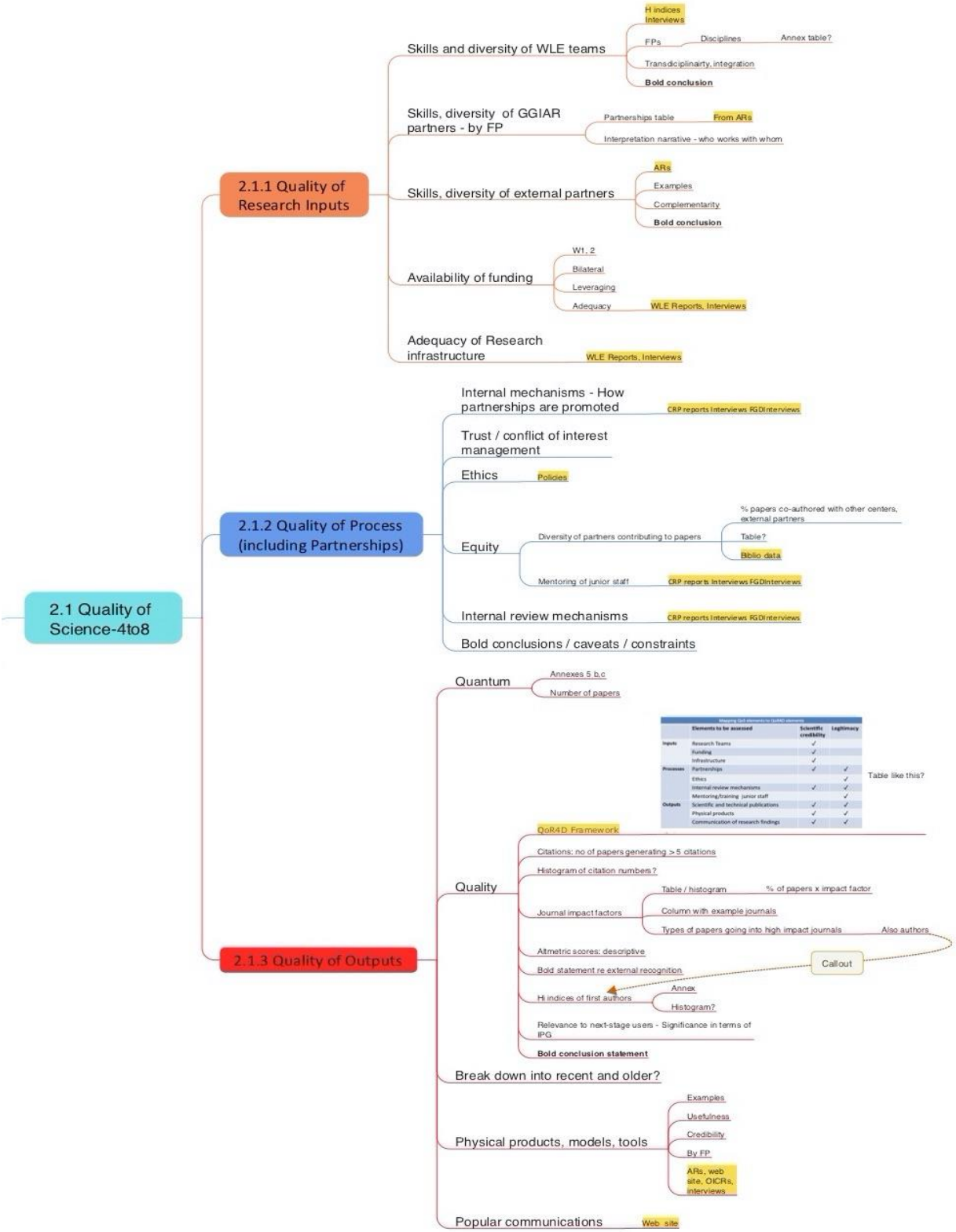
Choice of OICRs for deep dives – From research to outcome

Evaluation of a water management training program in Tajikistan leads to redesign to target women farmers and informs Feed the Future Learning Agenda (WLE-IWMI) (#6)

Building community prosperity through scaling out WLE/ICRISAT agricultural water management interventions for sustainable crop intensification in Central India (#11)

WLE/ICRISAT integrates smart water management tools and Innovation Platforms in small-scale Zimbabwean irrigation schemes to deliver enhanced water productivity, incomes, and conflict reduction (#19)

Figure 3. Mind map to direct the flow of focus group conversations



Annex 6: Bibliometrics and Altmetrics

6.1: Quality of Research Inputs

Table 1. WLE Phase 2 - Top 10 WLE authors of reports and journal articles from CGSPACE database

2017		2018		2019	
All publications (149)	Journal articles (62)	All publications (294)	Journal articles (108)	All publications (226)	Journal articles (101)
Fradi, Fajr (29)	Bjornlund, Henning (5)	Drechsel, Pay (38)	Ringler, Claudia (8)	Debevec, Liza (11)	Nhamo, Luxon (8)
Le, Quang Bao (28)	DeClerck, Fabrice A.J. (5)	Otoo, Miriam (30)	Aynekulu, Ermias (6)	Barron, Jennie (10)	Mabhaudhi, T. (6)
Diwediga, Badabate (20)	Sommer, Rolf (4)	Rao, Krishna C. (30)	Amarnath, Giriraj (5)	Nhamo, Luxon (10)	Villholth, Karen G. (6)
Bonaiuti, Enrico (19)	Aynekulu, Ermias (3)	Gebrezgabher, Solomie A. (25)	Drechsel, Pay (5)	Villholth, Karen G. (10)	Ebrahim, Girma Yimer (5)
Thomas, Richard (15)	Drechsel, Pay (3)	Hanjra, Munir A. (25)	DeClerck, Fabrice A.J. (4)	Mabhaudhi, T. (8)	Lefore, Nicole (5)
Lala-Pritchard, Tana (12)	Fonte, Steven J. (3)	Mateo-Sagasta, Javier (12)	Gumma, Murali K. (4)	Schmitter, Petra (8)	McCartney, Matthew P. (5)
Graziano, Valerio (11)	Jarvis, Devra I. (3)	Ringler, Claudia (12)	Lacombe, Guillaume (4)	IWMI (7)	Ringler, C. (5)
Zucca, Claudio (10)	Ocampo Pérez, John A. (3)	Hope, L. (11)	Mul, Marloes L. (4)	Lefore, Nicole (7)	Ringler, Claudia (5)
DeClerck, Fabrice A.J. (9)	Siles, Pablo (3)	Amerasinghe, Priyanie H. (8)	Nhamo, Luxon (4)	McCartney, Matthew P. (7)	Shepherd, Keith (5)
Gauchan, D. (8)	Adimassu, Zenebe (2)	Barron, Jennie (7)	Schmitter, Petra (4)	Pavelic, Paul (7)	Luedeling, Eike (4)

N.B. Numbers in brackets represent number of peer reviewed papers or reports.

Table 2. Most productive WLE-affiliated authors and H indices

Authors	Articles	H Index
RINGLER.C	14	30
NHAMO.L	11	11
SCHMITTER.P	8	11
SOMMER.R	8	22
ADIMASSU.Z	7	8
BJORNLUND.H	7	21
MONDAL.MAH	7	18
MABHAUDHI.T	6	13
TAMENE.L	6	16
BRYAN.E	5	11
DECLERCK.F	5	31
GUMMA.MK	5	25
LUEDELING.E	5	32
MEINZEN.DICK.R	5	22
MODI.AT	5	15
MPANDELI.S	5	4
TILAHUN.SA	5	17
VAN [ROOYEN] [3]	5	13?
YOU.L	5	22
AHMED.S	4	14
AYNEKULU.E	4	10
BAIJUKYA.F	4	5
BARRON.J	4	13
BUERKERT.A	4	33
CHAPLIN.KRAMER.R	4	22

[3] The bibliometrics database uses this surname "Van" without an H Index and contains a footnote that the name is incomplete. Probably refers to “Van Rooyen” who has an H index of 13 on Scopus

Table 3. Sources of WLE funding (budgeted for 2020)

Funding source	Amount
SMO - CGIAR System Organization	USD 8,059,704,84
USAID - U.S. Agency for International Development[4]	USD 2,873,785,00
IFAD - International Fund for Agricultural Development	USD 2,432,116,00
SIDA - Swedish International Development Agency	USD 2,114,648,00
AfDB - African Development Bank Group	USD 1,428,080,00
GIZ - Deutsche Gesellschaft für Internationale Zusammenarbeit / German Society for International Cooperation	USD 1,423,082,77
FAO - Food and Agriculture Organization of the United Nations	USD 1,415,782,34
BMZ - Bundesministerium für wirtschaftliche Zusammen-arbeit und Entwicklung/Federal Ministry of Economic Cooperation and Development (Germany)	USD 1,257,164,67
SDC - Swiss Development Cooperation	USD 1,162,816,00
EU - European Union	USD 1,091,755,00
Texas A&M University	USD 1,040,171,69
IITA - International Institute of Tropical Agriculture	USD 1,023,362,00
BMU - Bundesministerium für Umwelt, Naturschutz, Bau und Reaktorsicherheit (Germany)	USD 999,616,00
BIOVERSITY - Bioversity International	USD 967,282,58
Republic of Haiti - Government of the Republic of Haiti	USD 943,754,00
ACIAR - Australian Center for International Agricultural Research	USD 909,901,00
UKRI - UK Research & Innovation	USD 867,238,00
The World Bank	USD 848,689,00
GEF - Global Environment Facility	USD 703,195,69
The Helmsley Charitable Trust	USD 685,998,00
Mercy Corps	USD 579,786,00
South African National Treasury	USD 500,000,00
Chemonics International	USD 466,048,00
OPM - Office of the Prime Minister (Uganda)	USD 436,844,00
iSDA - Innovative Solutions for Decision Agriculture	USD 420,297,00
IDB - Islamic Development Bank	USD 397,071,00
MCC - Millennium Challenge Corporation	USD 395,967,00

[4] USAID contribution excludes funding channeled through partners. E.g. One of the largest bilateral projects is ILSSI (Innovation Lab for Small-Scale Irrigation), where USAID funds are channeled via contracts with Texas A&M

Funding source	Amount
ADB - Asian Development Bank	USD 373,743,00
MAFF - Ministry of Agriculture, Forestry and Fisheries (Japan)	USD 324,386,00
DGIS - Ministry of Foreign Affairs of Netherlands	USD 315,735,00
Government of United Kingdom	USD 295,000,00
ICAR - Indian Council of Agricultural Research	USD 289,294,00
Irish Aid	USD 288,000,00
SRTT - Sir Ratan Tata Trust & Allied Trusts	USD 279,666,00
Government of Ethiopia	USD 243,000,00
ISTC - International Science and Technology Center	USD 240,000,00
ILRI - International Livestock Research Institute	USD 235,195,00
David and Lucile Packard Foundation	USD 213,900,00
BMGF - Bill & Melinda Gates Foundation	USD 211,958,00
SDTT - Sir Dorabji Tata & Allied Trusts	USD 171,222,00
SLU - Swedish University of Agricultural Sciences	USD 152,528,00
CARE - CARE	USD 150,000,00
Government of Uttar Pradesh (India)	USD 150,000,00
ICRAF - World Agroforestry Centre	USD 150,000,00
ITC - India Tobacco Company	USD 142,596,00
EC - European Commission	USD 141,253,00
IWMI - International Water Management Institute	USD 132,000,00
OPML - Oxford Policy Management Limited	USD 128,512,00
DFID - Department for International Development (United Kingdom)	USD 125,760,00
CRS - Catholic Relief Services	USD 117,848,00
eWater Ltd	USD 116,548,00
MALF - Ministry of Agriculture, Livestock and Fisheries (Kenya)	USD 100,155,00
University of Oxford	USD 100,000,00
Government of Italy	USD 98,766,95
IIASA - International Institute for Applied Systems Analysis	USD 85,063,00
NASA-GSFC - NASA Goddard Space Flight Center (United States)	USD 83,580,00
Simavi	USD 80,000,00
UN Environment - United Nations Environment Programme	USD 79,440,00
<Not Defined>	USD 77,672,00

Funding source	Amount
George Mason University	USD 71,676,32
Hivos	USD 71,500,00
Penn State - Pennsylvania State University	USD 69,083,00
MEDA - Mennonite Economic Development Associates	USD 68,859,00
TNC - The Nature Conservancy	USD 62,000,00
SDSN - Sustainable Development Solutions Network	USD 60,000,00
NSF - National Science Foundation (United States)	USD 59,669,25
AIIB - Asian Infrastructure Investment Bank	USD 57,818,00
INRA - Institut National de la Recherche Agronomique	USD 52,440,00
IDRC - International Development Research Centre	USD 50,252,00
EBRD - European Bank for Reconstruction and Development	USD 45,401,00
SEI - Stockholm Environment Institute	USD 39,271,00
Ministry of Foreign Affairs of Denmark	USD 38,354,00
The Rockefeller Foundation	USD 37,064,00
ANAS - Azerbaijan National Academy of Sciences	USD 34,921,00
Government of Karnataka (India)	USD 30,029,00
Wetlands International	USD 29,235,00
DFAT-AU - Australian Government Department of Foreign Affairs and Trade	USD 27,988,00
Mars, Incorporated	USD 25,513,00
CAS - Chinese Academy of Sciences	USD 25,000,00
Mathematica Policy Research	USD 20,000,00
University of Reading	USD 10,000,00
UNDP - United Nations Development Programme	USD 7,862,00
UNICEF - United Nations Children's Fund	USD 7,350,00

Table 4. WLE funding by flagship (1000's of USD)

	2019		2018		2017	
Flagship	W1/2	W3/ bilateral	W1/2	W3/ bilateral	W1/2	W3/ bilateral
FP1RDL (Restoring Degraded Landscapes)	1,762	9,543	1,674	9,050	1,997	9,051
FP2 LWS (Land and Water Solutions for Sustainable Intensification	1,580	8,206	1,688	9,557	1,671	9,752
FP3 RUL (Sustaining Rural Urban Linkages	951	2,933	992	1,827	955	1,633
FP4 VCR (Managing Resource Variability, Risks, and Competing Uses for Increased Resilience)	1,395	1,916	1,398	4,257	1,515	557
FP5 ESA (Enhancing Sustainability across Agricultural Systems	800	621	349	2 422	0	3 438
Totals	6,488	23,219	6,101	27,113	6,138	24,431
		29,707		**33,214**		**30,569**

6.2. Partnerships

Table 5. Key external WLE partners

Lead Flagship	Brief description of collaboration	Key external partners in partnership
1	Rothamsted Research supports reference for calibration of WLE's dry spectral calibrations and partners on the Africa Soil Information Service project and development of new initiatives to take advances to scale.	Rothamsted Research, International Institute of Tropical Agriculture (IITA).
1	Africa Soil Information Service furthers the development of state-of-the-art national soil information systems based on soil-plant dry spectral analysis and digital soil property mapping.	Governments of Ethiopia, Ghana, Nigeria, and Tanzania, Rothamsted Research, World Soils Information (ISRIC), Columbia University, Quantitative Engineering Design (QED).
1	International/ national, scientific/academic partnership to assess sustainability at household and landscape levels to determine how land-based options contribute to building sustainable landscapes; and at country level to determine how far they are towards the achievement of SDGs, and the trade-offs and synergies among objectives.	Potsdam Institute for Climate Impact Research (PIK, Germany), University of Amazonia (Colombia), National Agrarian University - La Molina (UNALM, Peru), Research Center for the Peruvian Amazon (IIAP, Peru), Amazon Institute for Scientific Research (SINCHI, Colombia), Research center for sustainable agricultural systems (CIPAV, Colombia), Ministry of Environment of Peru (MINAM) and Ministry of Environment of Colombia (MADS).
1	A partnership for developing decision support tools to provide solutions to water management challenges in Honduras.	United States Agency for International Development (USAID), Ministry of Environment of Honduras.
1	Promotes dialogue between scientists and policy makers on desertification, land degradation and drought (DLDD).	United Nations Convention to Combat Desertification Science-Policy Interface (SPI).
2	Flagship 2 activities are linked with other CGIAR and external partner joint initiatives, including the Innovation Lab for Small-Scale Irrigation which includes Texas A&M University, International Water Management Institute (IWMI), International Livestock Research Institute (ILRI) and IFPRI.	Texas A&M University, United States Agency for International Development (USAID), Tufts University and Addis Ababa University.
2	Influencing the key messages going to the High-Level Political Forum on the review of the nutrition targets under the SDGs.	United Nations Standing Committee on Nutrition.
2	A research collaboration between International Food Policy Research Institute (IFPRI) and University of Development Studies, Ghana (UDS) on the impacts of a motor pump experiment.	University for Development Studies, Ghana.

Lead Flagship	Brief description of collaboration	Key external partners in partnership
2	Agricultural Transformation Agency (ATA) is implementing solar pumps in 16 districts in Ethiopia. ATA asked IWMI to undertake impact assessment and support in planning given past experience in pilot schemes.	Agricultural Transformation Agency, Ethiopia.
3	Uptake of WLE research on Resource, Recovery and Reuse (RRR) business models.	Discussions with 19 universities so far (list available).
3	Support of United Nations publications.	FAO, World Health Organization (WHO), UN Environment (UNEP).
3	Public Private Partnerships on Fortifer production.	Municipality of Yilo Krobo and Jekora Ventures Limited.
3	Advisor on food and the circular economy.	Ellen MacArthur Foundation.
4	WLE continues to liaise with the Food, Energy-Environment and Water Network (FE2W network) which supports co-development and implementation of Nexus tools and approaches.	Australian National University, and several other universities and partners as reflected on the network website.
4	Integration of innovative nature-based solutions to climate adaptation into city planning.	EstudioOCA (Bangkok based urban planning and architecture company), Sri Lanka Urban Development Authority and other national partners.
4	The Sustainable Water Future Programme (Water Future) of Future Earth is a global platform facilitating international scientific collaboration to drive solutions to water problems. WLE is part of this, through the International Water Management Institute (IWMI).	Griffith University and other partners of the Water Program under Future Earth.
4	Ramsar Science and Technical Review Panel (STRP): WLE continues to participate in the Scientific and Technical Review Panel, which provides scientific and technical guidance to the Conference of the Parties, the Standing Committee, and the Ramsar Secretariat.	Ramsar Convention. Key Organizational partners include Wetlands International, World Wildlife Fund (WWF), Birdlife International, International Union for Conservation of Nature (IUCN), and Wildfowl & Wetlands Trust.
5	University of Bonn is a partner in Flagship 5's decision analysis work, providing scientific and technical support and student co-supervision.	Department of Horticulture of the University of Bonn, World Agroforestry Centre (ICRAF).
5	Working with World Agroforestry Centre (ICRAF) in Disa Forest, Tigray.	WeForest, Ethiopia.

Table 6. Key CGIAR partners of WLE

Brief description of the collaboration	Key CGIAR partners
The collaboration between WLE Flagship 5 (ESA) and Flagship 1 (RDL) and PIM and FTA aims to bring together complementary research and evidence on landscape restoration from across the three CRPs, and channel this in a user-friendly format, that delivers targeted advice to policy and investment processes on land restoration. In August 2018, WLE participated in the Global Landscape Forum Nairobi at the panel of the discussion: Improving land governance and land use planning for Landscape restoration in Africa. WLE presented perspectives of land property rights in the context of land restoration initiatives in Africa and Latin America. https://events.globallandscapesforum.org/agenda/nairobi-2018/day-2-thursday-30-august-2018/parallel-sessions-3/3-parallel-discussion-forums-3/improving-land-governance-and-land-use-planning-for-landscape-restoration-in-africa/	CGIAR Research Program on *Policies, Institutions and Markets* (PIM) and CGIAR Research Program on *Forest, Trees and Agroforestry* (FTA).
As part of a collaboration between WLE and CGIAR Research Program on *Climate Change, Agriculture and Food Security* (CCAFS), Centro Internacional de Agricultura Tropical (CIAT) and the International Institute for Tropical Agriculture (IITA) worked with stakeholders part of the "Lushoto District Climate Change Learning Alliance" in identifying priorities, practices and the enabling environment required to achieve land restoration.	WLE and CGIAR Research Program on *Climate Change, Agriculture and Food Security* (CCAFS)/Centro Internacional de Agricultura Tropical (CIAT) and the International Institute for Tropical Agriculture (IITA).
WLE seeks to leverage evidence-based policy advocacy geared towards sustainable intensification at the landscape scale. Support was initiated for a CGIAR Research Program on *Forest, Trees and Agroforestry* (FTA) project on forest restoration in Ethiopia in partnership with weForest to analyze and improve proposed restoration interventions. WLE also supported FTA in the Kenya drylands by applying decision analysis methods.	CGIAR Research Program on *Forest, Trees and Agroforestry* (FTA).
WLE and the CGIAR Research Program on *Livestock,* Environmental Flagship, work together in the study: Rangeland Degradation: Causes, Consequences, Monitoring Techniques and Remedies; with a focus on soil-based solutions in Africa.	CGIAR Research Program on *Livestock*.
Flagship 1 provided advisory, analytical and capacity development services on soil-plant spectroscopy, including to the Soil Intelligence System for India, and the Africa Cassava Agronomy Initiative (ACAI).	CGIAR Research Program on MAIZE and CGIAR Research Program on *Roots, Tubers and Bananas* (RTB).
Flagship 2 activities are linked to Phase 2 of the Gender and Assets in Agriculture Program, led by the International Food Policy Research Institute (IFPRI) and funded by Bill and Melinda Gates Foundation, and CGIAR Research Program on *Agriculture for Nutrition and Health* (A4NH). WLE contributes to research under this program.	CGIAR Research Program on *Agriculture for Nutrition and Health* (A4NH).

Brief description of the collaboration	Key CGIAR partners
Flagship 2 maintains close collaboration with CGIAR Research Program on *Climate Change, Agriculture and Food Security* (CCAFS) on solar irrigation work in India (see OI), which has resulted in major expanded investment by the Indian Government. Flagship 4 continued collaboration with CCAFS on managed aquifer recharge for flood mitigation with a focus on capacity building and engagement, leading to handover of the Indian trial site to government and ratification of the concept and a commitment to scaling it out in Uttar Pradesh state. In Vietnam, the trials, comprising an assessment of volumes of water recharged, water quality and cost effectiveness of Managed Aquifer Recharge (MAR) interventions, continued throughout 2018. The joint WLE - CCAFS trials on index-based flood insurance were scaled-up (400 farmers in 11 villages). Consideration is now being given for 2019 for a greater focus on post-flood recovery – including "bundling" Index Based Flood Insurance with the dissemination of stress-tolerant crop varieties and broadening the CGIAR collaboration to encompass other centers and CRPs. Flagship 1 together with CCAFS, 4p1000, and Southern African Confederation of Agricultural Unions organized the side event on "Agriculture Advantage 2.0" at the United Nations Framework Convention on Climate Change COP24, in December 2018.	CGIAR Research Program on *Climate Change, Agriculture and Food Security* (CCAFS).
Flagship 2 Natural Resource Management are part of the Africa RISING initiative in Ethiopia, which includes partners from WLE (CIAT, ILRI, ICRISAT) and outside of WLE (ILRI, IITA). Watershed research is also part of Africa RISING in West Africa.	International Livestock Research Institute (ILRI), International Institute of Tropical Agriculture (IITA).
Flagship 2 partners (ICARDA-ICRISAT-IFPRI-IWMI) contributed to the research agenda of the DryArc draft concept note 2019-2021: Proof of Concept of a New Interface of the CGIAR for the Drylands.	DryArc is a cross Center initiative which involves ICARDA (lead), ICRISAT, IWMI and IFPRI.
CGIAR Research Program on *Grains, Legumes and Dryland Cereals* (GLDC) Flagship 3 explores how farm level interventions impact household food security and incomes, while WLE Flagship 2 works at scales above the farm (watershed and landscape) to understand the tradeoffs, synergies and environmental impacts of interventions on many farms in a community and to evaluate the impacts of sustainable intensification at scale.	CGIAR Research Program on *Grains, Legumes and Dryland Cereals* (GLDC).
WorldFish reviewed the Flagship 3 report on wastewater & aquaculture in Kumasi, Ghana.	WorldFish.
Flagship 4 has collaborated extensively with the FISH CRP in 2018 with work in The Ayeyarwady Delta Myanmar on flood based farming systems and on reservoir fisheries and fisheries and water control infrastructure. In 2018, Flagship 4 strengthened its collaboration with CGIAR Research Program on *Fish Agri-food Systems* (FISH) through collaborative work on water control infrastructure and fisheries. This included a jointly funded workshop on fisheries productivity in relation to human-made infrastructure and the publication of a joint brief on *Enhancing fisheries productivity through improved Management of reservoirs, dams and other water control structures.* In 2019 it is planned to further broaden the collaboration through a joint WLE-FISH-RICE focusing on research to create new knowledge and innovations on the sustainable intensification of rice-fish production systems.	CGIAR Research Program on *Fish Agri-food Systems* (FISH). CGIAR Research Program on *Rice* (RICE).

Brief description of the collaboration	Key CGIAR partners
Flagships 3 and 4 collaborated with CGIAR Research Program on *Agriculture for Nutrition and Health* (A4NH) on a joint session at Stockholm World Water Week on Water use, food security and disease – achieving healthy outcomes, which focused on how climate change and other drivers affect mosquito habitats and how to manage water accordingly, including infrastructure such as dams for irrigation. WLE also engaged with the new CGIAR Antimicrobial Resistance Hub to deliver a joint postdoctoral fellow position between the International Water Management Institute (IWMI) and the International Livestock Research Institute (ILRI).	International Livestock Research Institute (ILRI).
FP4 continued to engage with PIM on integrated assessment modelling to understand the impact of irrigation development on food import dependency of Sub-Saharan Africa and with PIM and CCAFS on joint assessment of the mitigation space through integrated water-energy-food nexus modelling.	CGIAR Research Program on *Policies, Institutions and Markets* (PIM), CGIAR Research Program on *Climate Change, Agriculture and Food Security* (CCAFS).
WLE seeks to leverage evidence-based policy advocacy geared towards sustainable intensification at the landscape scale. Support was initiated for an FTA project on forest restoration in Ethiopia in partnership we weForest to analyze and improve proposed restoration interventions.	CGIAR Research Program on *Roots, Tubers and Bananas* (RTB).
Flagship 5 is working in partnership with the CGIAR Research Program on *Roots, Tubers and Bananas* (RTB) (CIAT, IITA and Wageningen) to establish a landscape case study in Uganda (Isingiro District). Work will get underway in 2019. Flagship 5 is also in discussion with partners in PIM about collaborating in India on the management on common land. Work will start in 2019.	CGIAR Research Program on *Roots, Tubers and Bananas* (RTB); CGIAR Research Program on *Policies, Institutions and Markets* (PIM).
WLE co-hosted a webinar on how to improve women's participation and benefits in irrigation schemes and the CRP Director participated in a key session at the Gender Platform event in Addis Ababa in September 2018.	CGIAR Gender Platform.

6.3: Quality of Research Outputs

Table 7. Top 10 Altmetric scores

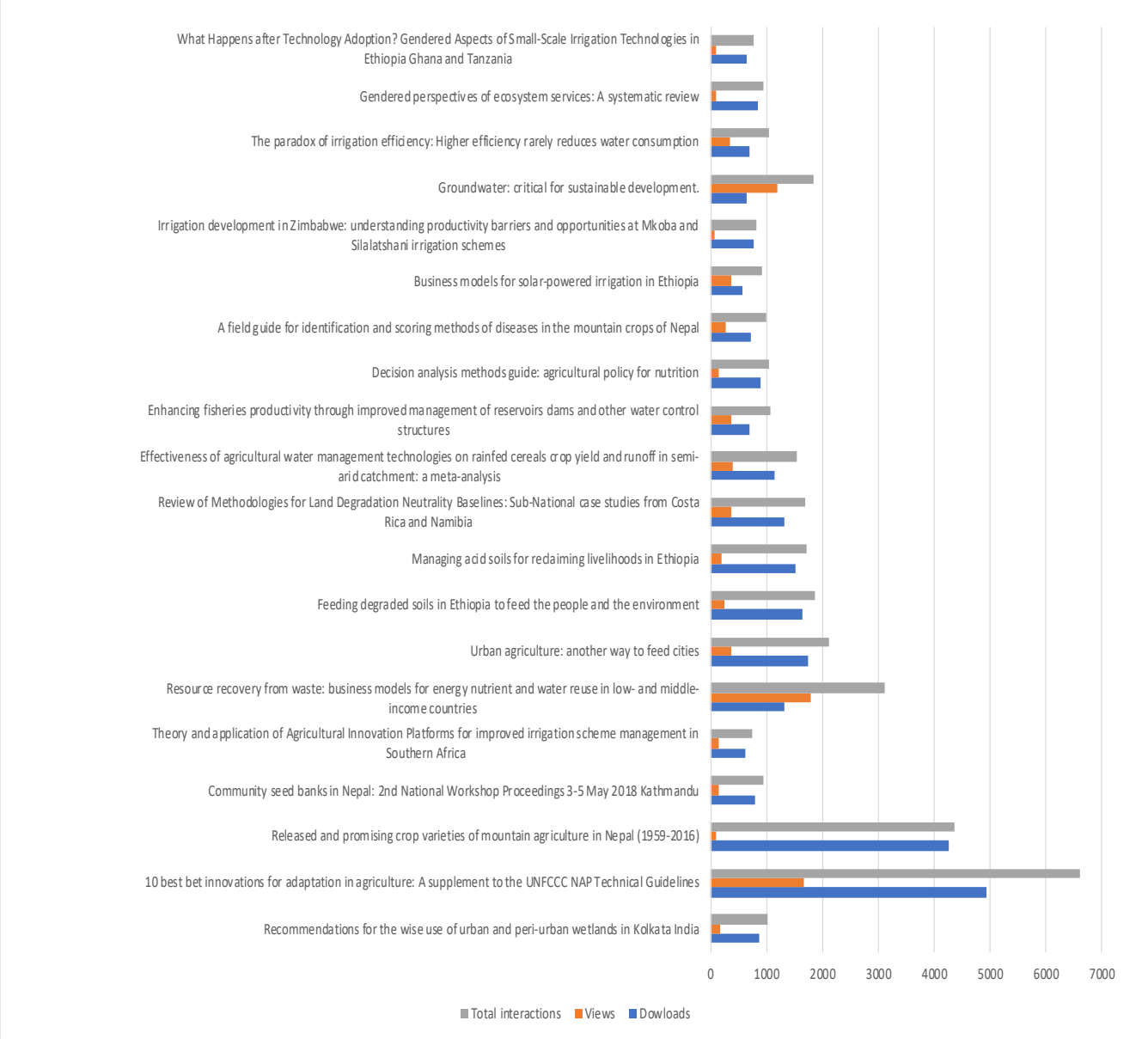
Article	Altmetric score
Dainese, M., Martin, E. A., Aizen, M. A., Albrecht, M., Bartomeus, I., Bommarco, R., Carvalheiro, L. G., Chaplin-Kramer, R., Gagic, V., Garibaldi, L. A., Ghazoul, J., Grab, H., Jonsson, M., Karp, D. S., Kennedy, C. M., Kleijn, D., Kremen, C., Landis, D. A., Letourneau, D. K., … Steffan-Dewenter, I. (2019). A global synthesis reveals biodiversity-mediated benefits for crop production. Science Advances, 5(10), eaax0121. https://doi.org/10.1126/sciadv.aax0121	547
Grafton, R. Q., Williams, J., Perry, C. J., Molle, F., Ringler, C., Steduto, P., Udall, B., Wheeler, S. A., Wang, Y., Garrick, D., & Allen, R. G. (2018). The paradox of irrigation efficiency. Science, 361(6404), 748–750. https://doi.org/10.1126/science.aat9314	428
Zomer, R. J., Bossio, D. A., Sommer, R., & Verchot, L. V. (2017). Global Sequestration Potential of Increased Organic Carbon in Cropland Soils. SCIENTIFIC REPORTS, 7. https://doi.org/10.1038/s41598-017-15794-8	392
Wible, B., Boyd, R., Richerson, P. J., Meinzen-Dick, R., De Moor, T., Jackson, M. O., Gjerde, K. M., Harden-Davies, H., Frischmann, B. M., Madison, M. J., Strandburg, K. J., McLean, A. R., & Dye, C. (2018). Tragedy revisited. SCIENCE, 362(6420, SI), 1236–1241. https://doi.org/10.1126/science.aaw0911	254
Cuthbert, M. O., Taylor, R. G., Favreau, G., Todd, M. C., Shamsudduha, M., Villholth, K. G., MacDonald, A. M., Scanlon, B. R., Kotchoni, D. O. V., Vouillamoz, J.-M., Lawson, F. M. A., Adjomayi, P. A., Kashaigili, J., Seddon, D., Sorensen, J. P. R., Ebrahim, G. Y., Owor, M., Nyenje, P. M., Nazoumou, Y., … Kukuric, N. (2019). Observed controls on resilience of groundwater to climate variability in sub-Saharan Africa. NATURE, 572(7768), 230+. https://doi.org/10.1038/s41586-019-1441-7	227
Wood, S. L. R., Jones, S. K., Johnson, J. A., Brauman, K. A., Chaplin-Kramer, R., Fremier, A., Girvetz, E., Gordon, L. J., Kappel, C. V, Mandle, L., Mulligan, M., O'Farrell, P., Smith, W. K., Willemen, L., Zhang, W., & DeClerck, F. A. (2018). Distilling the role of ecosystem services in the Sustainable Development Goals. ECOSYSTEM SERVICES, 29(A), 70–82. https://doi.org/10.1016/j.ecoser.2017.10.010	206
Karp, D. S., Chaplin-Kramer, R., Meehan, T. D., Martin, E. A., DeClerck, F., Grab, H., Gratton, C., Hunt, L., Larsen, A. E., Martinez-Salinas, A., O'Rourke, M. E., Rusch, A., Poveda, K., Jonsson, M., Rosenheim, J. A., Schellhorn, N. A., Tscharntke, T., Wratten, S. D., Zhang, W., … Zou, Y. (2018). Crop pests and predators exhibit inconsistent responses to surrounding landscape composition. PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES OF THE UNITED STATES OF AMERICA, 115(33), E7863–E7870. https://doi.org/10.1073/pnas.1800042115	187
Garrick, D., De Stefano, L., Yu, W., Jorgensen, I., O'Donnell, E., Turley, L., Aguilar-Barajas, I., Dai, X., Leao, R. de S., Punjabi, B., Schreiner, B., Svensson, J., & Wight, C. (2019). Rural water for thirsty cities: a systematic review of water reallocation from rural to urban regions. ENVIRONMENTAL RESEARCH LETTERS, 14(4). https://doi.org/10.1088/1748-9326/ab0db7	178
Rockstrom, J., Williams, J., Daily, G., Noble, A., Matthews, N., Gordon, L., Wetterstrand, H., DeClerck, F., Shah, M., Steduto, P., de Fraiture, C., Hatibu, N., Unver, O., Bird, J., Sibanda, L., & Smith, J. (2017). Sustainable intensification of agriculture for human prosperity and global sustainability. AMBIO, 46(1), 4–17. https://doi.org/10.1007/s13280-016-0793-6	104
Anderson, E. P., Jackson, S., Tharme, R. E., Douglas, M., Flotemersch, J. E., Zwarteveen, M., Lokgariwar, C., Montoya, M., Wali, A., Tipa, G. T., Jardine, T. D., Olden, J. D., Cheng, L., Conallin, J., Cosens, B., Dickens, C., Garrick, D., Groenfeldt, D., Kabogo, J., … Arthington, A. H. (2019). Understanding rivers and their social relations: A critical step to advance environmental water management. WILEY INTERDISCIPLINARY REVIEWS-WATER, 6(6). https://doi.org/10.1002/wat2.1381	99
Cai, Y., Guan, K., Lobell, D., Potgieter, A. B., Wang, S., Peng, J., Xu, T., Asseng, S., Zhang, Y., You, L., & Peng, B. (2019). Integrating satellite and climate data to predict wheat yield in Australia using machine learning approaches. AGRICULTURAL AND FOREST METEOROLOGY, 274, 144–159. https://doi.org/10.1016/j.agrformet.2019.03.010	86
Gleeson, T. (2019). Groundwater: a call to action. NATURE, 576(7786), 213.	80

Article	Altmetric score
Theis, S., Lefore, N., Meinzen-Dick, R., & 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), 671–684. https://doi.org/10.1007/s10460-018-9862-8	78
Kibret, S., Lautze, J., McCartney, M., Nhamo, L., & Yan, G. (2019). Malaria around large dams in Africa: effect of environmental and transmission endemicity factors. MALARIA JOURNAL, 18(1). https://doi.org/10.1186/s12936-019-2933-5	59
Romijn, E., Coppus, R., De Sy, V., Herold, M., Roman-Cuesta, R. M., & Verchot, L. (2019). Land Restoration in Latin America and the Caribbean: An Overview of Recent, Ongoing and Planned Restoration Initiatives and Their Potential for Climate Change Mitigation. FORESTS, 10(6). https://doi.org/10.3390/f10060510	55

Table 8. Number of WLE reports by region, from CGSPACE database

Region	Number of reports
Africa	98
Southern Asia	64
Eastern Africa	52
Western Africa	39
Asia	22
Africa South of Sahara	19
Central Asia	19
Southern Africa	19
Latin America	13
South-eastern Asia	13
East Asia	9
South America	8
Middle East	7
Central America	6
Northern Africa	6
Caribbean	4

Figure 4. Top 20 WLE publications downloaded from the CGSPACE database



N.B. Titles in blue represent peer reviewed papers.

Figure 5. Word cloud of WLE project titles in projects database (top 20 words only)

Table 9. Detailed analysis of select papers with highest Altmetric scores

Citation	Impact factor	Applicability of knowledge to WLE;0= results not relevant ;1=no broader applicability (local relevance only) 2= potentially broader applicability, but not spelled out;3= broader applicability is presented;4= significant international applicability;	Quality and appropriateness of publication venue	Co-authorship	Contribution from WLE	Overall quality / Altmetric score
Zomer, R. J., Bossio, D. A., Sommer, R., & Verchot, L. V. (2017). Global Sequestration Potential of Increased Organic Carbon in Cropland Soils. Scientific Reports, 7. https://doi.org/10.1038/s41598-017-15794-8	4.0	4. Estimates that improved land-use practices could increase the amount of carbon stored in the top layer of soils worldwide by between 0.9 and 1.85 billion metric tons each year; as much carbon as is emitted by the transportation sector annually. Major implications for climate change mitigation and justification of WLE's work	One of the top referenced journals world-wide, read by a wide range of disciplines	Three of four authors are/were with CGIAR (CIAT)	Significant. Bossio, Zommer and Sommer designed the study; Zommer performed the geospatial analysis, All authors. analyzed the data sets; all authors co-wrote the paper; Zommer produced all maps, tables and figures.	Cited 53 times - amongst the top 10 most cited papers with highest Altmetric score (392). Prominent article on the potential of soil carbon for climate mitigation in Nature Scientific Reports which received a score of 292, as it was supported through presentations at large events, media outreach and interviews, blogs and an infographic. 349 tweeters; 10 blogs; 16 news outlets; 367 Mendeley
Grafton, R. Q., Williams, J., Perry, C. J., Molle, F., Ringler, C., Steduto, P., Udall, B., Wheeler, S. A., Wang, Y., Garrick, D., & Allen, R. G. (2018). The paradox of irrigation efficiency. *Science*, *361*(6404), 748–750. https://doi.org/10.1126/science.aat9314	42.0	4. Multi-disciplinary journal with wide readership. substantial scientific evidence (2) has long shown that increased IE rarely delivers the presumed public-good benefits of increased water availability. Decision-makers typically have not known or understood the importance of basin-scale water accounting or of the behavioral responses of irrigators to subsidies to increase IE. We show that to mitigate global water scarcity, increases in IE must be accompanied by robust water accounting and measurements, a cap on extractions, an assessment of uncertainties, the valuation of trade-offs, and a better understanding of the incentives and behavior of irrigators.	Amongst the top-rated journals in multi-disciplinary science, followed by many media outlets	11 authors from different institutions	One of 11 authors = Ringler with WLE	146 citations, article has an Altmetric score of 428; top 5% of scientific contributions Picked up by 7 news outlets Blogged by 6 Referenced in 2 policy sources Tweeted by 471 On 6 Facebook pages Mentioned in 3 Google+ posts Reedited by 2 352 readers on Mendeley 1 reader on CiteULike

Citation	Impact factor	Applicability of knowledge to WLE;0= results not relevant ;1=no broader applicability (local relevance only) 2= potentially broader applicability, but not spelled out;3= broader applicability is presented;4= significant international applicability;	Quality and appropriateness of publication venue	Co-authorship	Contribution from WLE	Overall quality / Altmetric score
Wood, S. L. R., Jones, S. K., Johnson, J. A., Brauman, K. A., Chaplin-Kramer, R., Fremier, A., Girvetz, E., Gordon, L. J., Kappel, C. V, Mandle, L., Mulligan, M., O'Farrell, P., Smith, W. K., Willemen, L., Zhang, W., & DeClerck, F. A. (2018). Distilling the role of ecosystem services in the Sustainable Development Goals. ECOSYSTEM SERVICES, 29(A), 70–82. https://doi.org/10.1016/j.ecoser.2017.10.010	6.3	3. Present the results of an expert survey on the contributions of 16 ecosystem services to achieving SDG targets linked to environment and human well-being, and review the capacity of modelling tools to evaluate SDG-relevant ecosystem services interactions. Survey respondents judged that individual ecosystem services could make important contributions to achieving 41 targets across 12 SDGs. The provision of food and water, habitat & biodiversity maintenance, and carbon storage & sequestration were perceived to each make contributions to >14 SDG targets, suggesting cross-target interactions are likely, and may present opportunities for synergistic outcomes across multiple SDGs. Existing modelling tools are well-aligned to support SDG-relevant ecosystem service planning. Together, this work identifies entry points and tools to further analyze the role of ecosystem services to support the SDGs.	Very relevant to WLE's work, high impact journal	17 authors	Lead author plus 3 others associated with WLE at time of publication	96 citations. Altmetric score = 206. Shares, Likes & Comments: 21 Tweets: 352.

Citation	Impact factor	Applicability of knowledge to WLE;0= results not relevant ;1=no broader applicability (local relevance only) 2= potentially broader applicability, but not spelled out;3= broader applicability is presented;4= significant international applicability;	Quality and appropriateness of publication venue	Co-authorship	Contribution from WLE	Overall quality / Altmetric score
Dainese, M., Martin, E. A., Aizen, M. A., Albrecht, M., Bartomeus, I., Bommarco, R., Carvalheiro, L. G., Chaplin-Kramer, R., Gagic, V., Garibaldi, L. A., Ghazoul, J., Grab, H., Jonsson, M., Karp, D. S., Kennedy, C. M., Kleijn, D., Kremen, C., Landis, D. A., Letourneau, D. K., … Steffan-Dewenter, I. (2019). A global synthesis reveals biodiversity-mediated benefits for crop production. Science Advances, 5(10), eaax0121. https://doi.org/10.1126/sciadv.aax0121	13.12	4. Using a global database from 89 studies (with 1475 locations), the authors assess the relative importance of species richness, abundance, and dominance for: pollination; biological pest control; and final yields in the context of ongoing land-use change. The negative effects of landscape simplification on ecosystem services was due to richness losses of service-providing organisms, with negative consequences for crop yields. Maintaining the biodiversity of ecosystem service providers is therefore vital to sustain the flow of key agroecosystem benefits to society.	A highly ranked multi-disciplinary journal which attracts a lot of media attention.	More than 80 authors. Wei Zhang of IPFRI is among them. Unclear how many others from WLE	The paper is prominently mentioned in the 2019 AR. It is assumed that partners in Wageningen are the main contributors. WLE is not mentioned in any of the author affiliations. Wei Zhang of IFPRI is among the authors.	97 citations in 12 months. Altmetric score = 547. Picked up by 28 news outlets Blogged by 8 Referenced in 2 policy sources Tweeted by 412 On 4 Facebook pages 516 readers on Mendeley

Citation	Impact factor	Applicability of knowledge to WLE;0= results not relevant ;1=no broader applicability (local relevance only) 2= potentially broader applicability, but not spelled out;3= broader applicability is presented;4= significant international applicability;	Quality and appropriateness of publication venue	Co-authorship	Contribution from WLE	Overall quality / Altmetric score
Cuthbert, M. O., Taylor, R. G., Favreau, G., Todd, M. C., Shamsudduha, M., Villholth, K. G., MacDonald, A. M., Scanlon, B. R., Kotchoni, D. O. V., Vouillamoz, J.-M., Lawson, F. M. A., Adjomayi, P. A., Kashaigili, J., Seddon, D., Sorensen, J. P. R., Ebrahim, G. Y., Owor, M., Nyenje, P. M., Nazoumou, Y., … Kukuric, N. (2019). Observed controls on resilience of groundwater to climate variability in sub-Saharan Africa. Nature, 572(7768), 230+. https://doi.org/10.1038/s41586-019-1441-7	43.0	4. recharge in drylands is more episodic and increasingly dominated by focused recharge through losses from ephemeral overland flows. The authors demonstrate that groundwater depletion in arid areas may be over-estimated. Using multidecadal groundwater hydrographs across sub-Saharan Africa they show that extreme annual recharge is commonly associated with intense rainfall and flooding events, themselves often driven by large-scale climate controls. Intense precipitation, even during years of lower overall precipitation, produces some of the largest years of recharge in some dry subtropical locations.	A highly ranked multi-disciplinary journal which attracts a lot of media attention.	28 authors	Karen G. Villholth & Girma Yimer Ebrahim of IWMI	31 citations in 12 months. Altmetric score=227 - among top 10%. 131 tweeters; 4 blogs; 24 news outlets; 144 Mendeley

Annex 7: WLE Outputs and Outcomes

7.1. Milestones

Completed
Extended
Cancelled
Changed

Figure 6: Status of WLE 2017-2019 milestones

	2017	2018	2019
Flagship 1: Restoring Degraded Landscapes			
Outcome 1.1: Better informed landscape restoration policies, approaches and interventions			
Knowledge products used by national governments or regional stakeholder platforms supporting implementation of innovative restoration pilots as well as national conservation and restoration planning in Kenya, Ghana, Tanzania and Ethiopia (2017 Extended)	Extended	Completed	
Private sector companies or foundations active in land restoration request WLE support for developing an investment-ready business portfolio (2017 Extended)	Extended	Completed	
Further investments made in land restoration pilots as a result of demonstrated improvements in ecosystems services provision	Completed		
Synthesis report of factors affecting success and failure of restoration initiatives (enabling factors and incentive schemes) leading to recommendations for the design of new restoration initiatives.		Completed	
Innovative investment packages and restoration pilots that implement incentives and enabling conditions for the adoption of sustainable and equitable restoration interventions in progress in 3 countries		Completed	Completed
Decision support tools for targeting restoration interventions finalized and presented to key stakeholders to inform restoration plans or investments in at least two countries (e.g. Ethiopia, Kenya, El Salvador)			Completed
Land restoration investment cases, built on scientific evidence generated from pilots implemented during 2016-2018, are finalized and shared with key public/private sector stakeholders in two countries (Kenya, Colombia and Peru)			Completed
Empirical evidence on good practices for gender-equitable restoration consolidated and shared with restoration practitioners (in at least 12 projects, 3 countries)			Completed
Outcome 1.2 Policies, strategies and interventions investing in practices that rehabilitate or protect soil fertility and soil carbon			
Kenyan county governments of Kakamega, Siaya and Bungoma consider including methodological guide on estimating and measuring soil carbon at various scales into their soil and landscape restoration planning and monitoring	Extended	Completed	
Two UNCCD LDN participating countries of the humid tropics request support for further advanced methods (such as mid-infrared spectroscopy -MIRS) for determining soil degradation status into their list of LDN progress monitoring indicators	Completed		
Increased visibility, reach and influence of WLE-RDL at the level of national and international platforms, such as AFR100, 20x20, GLF, 4p1000, and within the UNCCD and UNFCCC COPs	Completed		
Understanding of gender, social and economic barriers to, and drivers of adoption of, soil conserving management practices gained in two countries, and insights shared with policy-makers in these countries		Completed	
Knowledge products (reviews, tools, methods, maps, statistics, and other noteworthy research outputs) on soil carbon sequestration in East Africa are (presented/discussed with key stakeholders at two international conferences		Completed	
At least two Kenyan county governments include methodological guide and farm-level DSS on estimating and measuring soil carbon and fertility at various scales into their soil and landscape restoration planning and monitoring		Extended	Completed
Predictive models to quantify the potential for soil carbon sequestration under differing management in tropical soils and landscapes developed and submitted for open-access publication in an international peer-reviewed journal		Completed	
Strengthened capacity of national science institutions to monitor and verify soil carbon stocks and measure soil health in land restoration and management projects in two East African countries			Completed
Mapping, quantification and technical analysis of soil carbon sequestration benefits from sustainable land management (SLM) in six watersheds in Ethiopia is completed and made available for policy-makers at UNCCD CoP14 and UNFCCC COP			Completed
National level engagement with key stakeholders in Uganda around the results of a soil health, land management and gender analysis leading to an improved understanding of how to deliver more gender responsive land management policies and decisions			Completed
Outcome 1.3 Strengthen approaches to the monitoring and evaluation of land restoration and the assessment of land degradation risks.			
Partnership with government and development agencies in Kenya and Tanzania produce data sets from multi-location agronomic trials demonstrating a soil-plant ionomics approach using dry spectral technology for predicting crop nutrient constraints.	Completed		
Framework paper presenting a new analytical approach for planning and performance management of land restoration initiatives integrating feedback from testing with development partners.	Extended	Extended	Completed
60 National scientists (20% women) trained and supported in applying low cost soil and plant health measurements using dry spectroscopy for targeting and monitoring land restoration in 8 countries (Ethiopia, Ghana, Kenya, India, Malawi, Nepal, Nigeria, and Tanzania).		Completed	
Decision Analysis Framework for Planning and Performance Measurement of Land Restoration Initiatives applied to UNCCD LDN case study and one land restoration project and improved based on feedback from stakeholders.		Completed	
Online tool set for management, analysis and application of soil-plant infrared spectroscopy data, including Africa soil property prediction, tested with 8 national labs, and improved based on feedback (Ethiopia, Ghana, Kenya, India, Malawi, Nepal, Nigeria, and Tanzania)		Extended	Completed
Integrated monitoring and evaluation approach, tools and analysis that builds on existing development activities for three land restoration initiatives scaled out in two countries (India and Mali).			Changed
Decision Analysis Framework and tools for Planning and Performance Measurement of Land Restoration is extended to three land restoration initiatives in two countries (Ethiopia and Kenya) leading to more contextually relevant restoration investment decisions.			Completed
Spectral-based soil information systems and Taking Agronomy to Scale Initiatives are scaled up to five additional African countries			Completed
Flagship 2: Land and Water Solutions for Sustainable Intensification			
Outcome 2.1: Policy and practice informed by more effective agricultural land and water management solutions and investment options			
Phase 1 business models reviewed (and as appropriate adapted/adopted) in public/private sector agencies in 6 countries	Completed		
Phase 1 recommendations on ALWM interventions evident in policy, investment and/or development programs in 3 countries: Ethiopia, Ghana and India	Completed		
At least 3 LWS investment options/business models refined and shared with public and private sector institutions in 2 countries		Completed	
Phase 1 and 2 gender tools refined to enable application by policy and investment actors in 2 countries, and the implications of Phase 1 and Phase 2 gender analyses communicated through presentations to policy-makers and investors at 3 events		Completed	
Agriculture, land, water management (ALWM) investment options shared in 2018, are further refined with stakeholders during out scaling of these technologies in 2 countries (or states)			Completed
Evidence of what works for: AWLM, watersheds and gender, soil and water management, reservoirs, communal irrigation, translated into policy recommendations and practitioner guidance and shared with national stakeholders			Completed
Outcome 2.2: Improved management of new and revitalized medium to large-scale irrigation schemes			
Farmers, scheme managers, investors and policy makers in medium and large scale irrigation systems, requested LWS-influenced new technologies and management approaches to improve productivity and income generation (targeting Zimbabwe and Myanmar)	Completed		
Improved baseline/benchmark indicator systems that enhance irrigation performance, gender equity and ecosystem services in 2 African irrigation investment efforts by IFAs and/or national public sector investment partners by end of 2018	Cancelled		
Identify how problematic large and medium scale irrigation schemes (LSIS) in 3 countries (India, Ethiopia, Egypt) can be improved by benchmarking tools, PPP arrangements and supporting capacity building needs in private and public irrigation sector	Extended	Completed	
Two African medium or large-sized irrigation schemes monitoring irrigation performance and showing increases in farmer incomes, gender equity and ecosystem services delivery		Completed	
Synthesized knowledge around technical, management and policy "levers of change" used in triggering new opportunities for scaling of at least 5 farm/field level innovations in irrigated systems in 2 countries		Completed	
Tools and institutional recommendations for improved irrigation scheme management disseminated through engagement in key platforms and partnerships with national policy makers and other stakeholders (1 African, 2 Asian countries)			Completed
National policy-makers, academics and key stakeholders gain accesses to improved evidence base on small-scale irrigation through the publication of Special Issue of International Journal of Water Resources Development			Extended
Consolidate transferring knowledge from tested WLE solutions on farm level tools and management into demonstration in irrigated systems in two countries			Extended

Flagship 3: Sustaining Rural Urban Linkages			
Outcome 3.1: Improved capacity of urban stakeholders to implement evidence-based policies and practices in support of urban food security and resilience			
Led by its agencies, 8 cities have implemented in-depth analysis on their food value chains and farming system for capacity development and policy advice			
4 cities have (gone a step further) and adopted a monitoring system for UPA/CRFS related innovations and development of food related indicators, policies and/or actions			
7 reports providing in-depth and focused food and farming system analysis in a minimum of 7 cities (Nairobi, Quito, Colombo, Cali, Palmira and 2 African Cities).			
Two additional cities adopt a monitoring system for UPA/City Region Food Systems (CRFS) related innovations (for a total of 5 cities)			
5 cities implement Milan Urban Food Policy Pact with WLE Facilitation			
Field tested methodology to assess and increase climate resilience in at least three city-region food systems			
Adoption of gender indicator recommendations into the Milan Urban Food Policy Pact (MUFPP) framework in four cities			
Outcome 3.2: Increase business capacities in nutrient, water and energy recovery from domestic and ago-industrial waste for intensified food crop production.			
Field trials for waste-based soil rehabilitation established for major plantation crops in Sri Lanka targeting recommendations for private sector investments on e.g. 180,000 ha under tea			
Business models (n=18) for resource recovery from fecal sludge promoted through the design of a free Massive Open Online Courses (MOOC) for entrepreneurs of both genders across Africa, Asia and Latin America, and support of start-ups on fecal sludge management in India.			
Advisory services to ADB and World Bank in Nepal and India for adoption and replication of resource oriented solid and liquid waste management in small towns with potential to impact about 300,000 people *			
Guidelines developed for the Indian Ministry of Urban Development on safety handling of fecal sludge and wastewater to be applied in ca. 8000 towns with potential to impact several million people*			
Private sector facilitated field trials for waste-based soil rehabilitation established in Sri Lanka, informing 18,000 ha under coconut, tea and rubber			
16 Business models for resource recovery from fecal sludge promoted through ongoing free Massive Open Online Courses (MOOC)			
Advisory services (including technical support, policy guidance, guidelines, etc) for adoption and replication of resource oriented solid and liquid waste management in small towns (up to 8000) established for World Bank and Government of India			
FAO adopts revised handbook on wastewater management for irrigation.			
Gender and Resource Recovery case studies referenced by stakeholders			
Six (plus) universities and business schools are using RRR teaching materials developed by WLE			
Completion of analysis of gender dynamics in resource recovery and reuse (RRR) and inclusive business models			
Flagship 4: Managing Resource Variability, Risks and Competing Uses for Increased Resilience			
Outcome 4.1: Uptake of solutions to enhance resilience to extreme water variability at different levels			
Flood insurance theoretical and institutional framework and tools (with insights for more equitable risk sharing for women) delivered to government partners and insurance companies (co-developed with CCAFS)			
Preliminary drought monitoring framework established and available to FAO and partners in Southern Africa			
Workplan with selected AFS-CRPs to support ex-ante analyses of water variability developed			
Regional flood and drought forecast and early warning tool developed for India/Sri Lanka with associated protocols distributed to relevant government agencies			
Index Based Flood Insurance business model published			
Innovative approaches for mitigating flood and drought risk and exploiting potential flood benefits tested in four countries (India, Vietnam, Myanmar and Sri Lanka) with associated recommendations and plans for upscaling developed			
WLE diagnostic and planning tools (particularly software) developed for flood and drought mitigation across Asia (Sri Lanka, Myanmar, Vietnam, India) are used and supported by national/state governments and UN-SPIDER			
Guidance on what mechanisms enable disadvantaged groups to benefit from insurance vehicles delivered and disseminated to relevant government agencies, insurance companies and NGOs in India and Bangladesh			
Outcome 4.2: Uptake of solutions and investment options better able to address tradeoffs across competing water-energy-food needs			
Methodology for the assessment of key targets under SDG 6 [water] and interlinkages developed			
Increased capacity in basin agencies for better management of combined portfolios of natural (green) and built (grey) infrastructure in the Volta and Tana basins to build greater resilience and enhanced ecosystem services			
At least 2 water-energy-food nexus initiatives and national strategies are informed by WLE technology, policy and institutional insights **			
Establishment of operational partnerships in the WLE Groundwater Solutions Initiative for Policy and Practice (GRIPP) Initiative **			
Groundwater information for Africa is used by 2 governments in their planning processes			
Capitalizing on the international focus on "nature-based solutions for water" in 2018, contribute to international dialogue through participation at 3 or more awareness raising events (e.g. World Water Forum, World Water Week, IPBES Conference of the Parties (COP) and Ramsar COP) and at least 5 communications pieces/products that			
2 or more tools for addressing tradeoffs across the water-energy-food nexus published			
Information on risks and opportunities associated with groundwater use applied and taken up with key Government partners in India and elsewhere.			
Completion of analysis of Africa wide potential and tradeoffs for solar-irrigation assessed across water-energy-food dimensions			
Decision support tools that facilitate greater understanding of inter-sector tradeoffs associated with different water management options developed and applied in at least one major basin in Africa and one in Asia			
Cohort of technical staff in relevant national and regional governments, as well as local partners, have new/improved knowledge, skills and confidence to employ nature-based solutions for improved surface and groundwater management			
Flagship 5: Enhancing Sustainability Across Agricultural Systems			
Outcome 5.1: Policy-makers have improved access to evidence, tools and expert advice to design and manage agriculture and natural resource interventions sustainably			
Redesigned Flagship submitted for approval taking into consideration reviewer comments.			
Results from bilateral projects incorporated into the redesign of Flagship 5.			
Evidence on specific ecosystem based approaches, such as agrobiodiversity conservation, generated.			
Publication of an approach and framework for supporting decision makers to manage better tradeoffs arising at scale from field level farming activities.			
Publication of refined decision analysis approaches for a better fit to NRM/sustainable agriculture decision making at the landscape scale.			
Publication of two reports on knowledge brokering approaches and policy interventions for NRM at the landscape scale are used for co-learning dialogue with key research partners (e.g. Food and Land Use Coalition)			
Decision support products and approaches from WLE projects assessed for different types of decision dilemmas, and screened for inclusion in decision support frameworks.			
Sustainable Agricultural Intensification Commission established to explore policy approaches to manage tradeoffs in smallholder agricultural landscapes between environmental sustainability, healthy diets and livelihoods			
Outcome 5.2: Natural and agricultural resource interventions are more cost-effective by minimizing negative tradeoffs that degrade landscapes			
Application of innovative decision-support tools applied across a sample of programs			
Work plans finalised for 3 new partnerships in three different farming systems (RTB, RICE, FTA).			
Completion of large-scale survey targeting key policy-makers (e.g., in NGOs, national governments, development banks, etc.) to identify gaps in capacity to use evidence, and to determine demand for decision support tools			
Pilot landscapes established and co-developed with stakeholders in three countries.			

7.2. Innovations, Policies and OICRs

Table 10. Overview of innovations, policies and OICRs by FP 2017–2019

FP1 - Restoring Degraded Landscapes [RDL] **CoA 1:1 Landscape Restoration** **CoA 1.2: Soil Restoration and Soil Carbon** **CoA 1.3: Restoration Assessment and Monitoring**		
Innovations: 11	**Policies: 4**	**OICRs: 6 + 1 Joint**
• Silvopastoral systems for degrading lands in the Colombian Amazon • Soil Data Manager • Online water planning tool for Honduras • Application of Big Data Analytics to Consolidate Fertilizer Trial Data into a Farmer-Support Tool • Re-configuring Community seed bank functions, by building on their social capital to incorporate landscape management and restoration • LandscapeCPR: Business model for landscape restoration in Makueni County, Kenya • Cropping system sustainability tool 'CROSST' is an Excel-based tool assessing both agro-environmental and socio-economic impacts of Green Manure Cover Crop (GMCC) technologies • Use of experiential games as a tool to help communities improve groundwater governance • DATAR: a new application for Diversity Assessment Tool for agrobiodiversity and resilience • Global Soil Data Manager application • Soil-plant spectral diagnostic protocols for rapid and low-cost analysis of soil properties and plant nutrients using only light (infrared, x-rays)	• Revised Ethiopian Soil Strategy which includes soil fertility management measures that will contribute to reducing soil degradation • WLE/Bioversity International support for development of new National Seed Policy aimed at agricultural transformation in Uganda • Support of adoption of the Government of Ethiopia's Soil and Agronomic Data Sharing Policy • Recommendations on soil carbon management and monitoring accepted by the United Nations Convention to Combat Desertification (UNCCD) Conference of the Parties	2205 - Evidence-based soils agronomy for raising crop production in Africa 2794 - Soil-plant spectral technology guiding soil fertility investments in Africa (WLE-ICRAF) 2793 - Water planning system "Agua de Honduras" used to improve Honduran investment decisions (WLE-CIAT) 3257 - New Ethiopian Ministry of Agriculture data sharing policy supported by WLE/CIAT and GIZ to improve food production while building landscape health 3337 - WLE/ICRAF soil spectral technology impacting soil restoration strategies and investments are being scaled up from Africa to global use 2204 - Ethiopia adopts WLE research findings to improve the returns on its massive investments in soil and water management (with FP2)
FP2 - Land and Water Solutions for Sustainable Intensification [LWS] CoA 2.1: ALWM Solutions for Resilient Smallholder Livelihood and Landscape Systems CoA 2.2: Unlocking Value in Irrigation Systems		
Innovations: 8	**Policies: 7**	**OICRs: 5 + 1 joint**

• Harnessing Ethiopian floodwaters helps dryland pastoralists and the approach is scaling up
• "Contour bunding" preserves soils and boosts farmers' incomes by 20% in Mali - a new study
• Designing low cost water harvesting system for Bundelkhand region and rejuvenating Haveli system
• Systems modelling (whole farm) as decision support evaluating impact of SLM strategies of household cashflows
• Collective action games to strengthen resource governance
• Developing government capacity in geospatial tools for land water analysis in Myanmar, enabling rice crop flood-damage prevention measures
• Application of new tool to map the economic and environmental suitability of solar irrigation in sub-Saharan Africa (with FP4)
• Guideline on setting up Water User Associations and supporting institutions in pump based irrigation schemes in Myanmar

• The Ethiopian Prime Minister approved a policy to make all water technologies tax exempt. This tax exemption aims to encourage the adoption of agricultural water technologies such as solar irrigation.
• Design of new investments by Government of India in grid connected solar pumps for irrigation, with surplus power buy-back arrangements (US$7,000M)
• Based on the demonstrated proof of concept of water spreading to manage extreme flooding across pastures in Afar state, eastern Ethiopia, the approach is being integrated into a major World Bank/ International Fund for Agricultural Development project
• Indian and Gujarat state governments rolling out national solar irrigation investment program based on results of WLE and CCAFS-supported pilot study. Farmers will be able to sell surplus power to electric utility (Related to OICR 2792)
• Based on a WLE-supported evaluation of the effectiveness of an irrigation management training program in Tajikistan, the United States Agency for International Development re-designed the program to target women, who are increasingly taking responsibility for management of the irrigation systems
• Uzbekistan agricultural development strategy
• WLE/IFPRI research feeds into World Bank Guidance on irrigation-nutrition linkages

2792 - A revolution in solar-powered Irrigation: Solar Power as Remunerative Crop (SPaRC) model is being scaled out nationwide in India (WLE-IWMI)
2773 - Evaluation of a water management training program in Tajikistan leads to redesign to target women farmers and informs Feed the Future Learning Agenda (WLE-IWMI)
2791 - Harnessing Ethiopian floodwaters helps dryland pastoralists – and the approach is being scaled up (WLE-ICRISAT)
3348 - Building community prosperity through scaling out WLE/ICRISAT agricultural water management interventions for sustainable crop intensification in Central India
3362 - WLE/ICRISAT integrates smart water management tools and Innovation Platforms in small-scale Zimbabwean irrigation schemes to deliver enhanced water productivity, incomes, and conflict reduction
2204 - Ethiopia adopts WLE research findings to improve the returns on its massive investments in soil and water management (with FP1)

FP3 - Rural and Urban Linkages [RUL])
CoA 3.1: City-Region Food Systems and Urban Food Security
CoA 3.2: Business Options for Nutrient, Water and Energy Recovery and Reuse

Innovations: 5

• WABEF, a toolkit to promote anaerobic digestion of bio-wastes in West Africa
• Fecal Sludge Management Business Model Tool
• Resource Recovery and Reuse business models have been incorporated into curricula of 8 universities in 6 countries
• Assessment of City Region Food System toolkit (RUAF/FAO)
• Milan Urban Food Policy Pact (MUFPP) Indicator Framework with gender lens, field tested in Nairobi

Policies: 2

• The Sri Lankan cabinet approval of the new National Sanitation Policy of Sri Lanka
• Municipal food security policy for a more integrated food security plan for the Cali urban region (Colombia)

OICRs: 2

2206 - Sri Lankan sanitation policy adopts recycling of septage for reuse as fertilizer
3363 - WLE/CIAT facilitated development and approval of the first municipal food security policy for Cali (Colombia) to support an integrated action plan

FP4 - Managing Resource Variability, Risks and Competing Uses for Increased Resilience [VCR]
CoA 4.1: Managing Resource Variability and Risks for Resilience
CoA 4.2: Managing Competing Uses and Trade-offs

Innovations: 3

• A Mobile Phone App that will provide more than half of Indian farmers with crop insurance in the next 2-3 years
• Mobile data entry for manual data
• Framework to assess data exchange in transboundary waters

Policies: 7

• Design of new investments by Government of India in groundwater irrigation (US$400M) in irrigation-deprived district
• The United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties formally recognized that increasing soil organic matter puts carbon back into the soil and hence can help mitigate climate change
• Supported by WLE and CCAFS, the South Asia Drought Monitoring System is being used by the Indian government to make cropping recommendations to farmers, target drought relief efforts and develop district contingency plans
• A WLE-supported methodology for monitoring environmental water flows for Sustainable Development Goal 6.4.2 has been adopted and disseminated by the United Nations for use in country reporting against the SDG Goal
• Availability models and tool for irrigation planning incorporated into Nepal's National Irrigation Master Plan (Related to OICR 3360)
• Laos national groundwater action plan and irrigation strategy & revised water resources law)
• The Vietnam Ministry of Agriculture and Rural Development has endorsed the policy recommendations on managed aquifer recharge (MAR) as a new agricultural extension tool

OICRs: 5

2795 - Environmental water flows go global to support implementation of the Sustainable Development Goals (SDGs) (WLE-IWMI)
2796 - Making the leap from drought monitoring to managing agricultural drought risks in India (WLE-IWMI)
3226 - Experiential games developed by WLE/PIM/IFPRI/ICRISAT are being scaled out to almost 250,000 households to improve ground and surface water governance in India
3360 - Nepal’s National Irrigation Master Plan adopts WLE/IWMI water availability calculations and tools
3364 - WLE/IWMI research and capacity building to support sustainable groundwater development and management in Laos influences policies and implementation programs

FP5 - Enhancing Sustainability across Agricultural Systems (ESA)
CoA 5.1: Assessing decision-support approaches for sustainable agricultural landscapes
CoA 5.2: Testing and refining approaches and tools to effectively deliver sustainability of landscapes at scale

Innovations: 5

Policies: 0

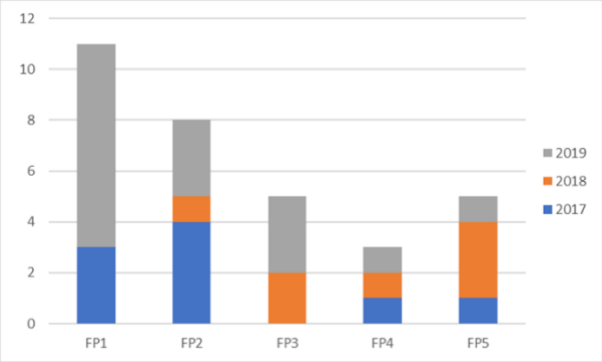
OICRs: 2

• Evaluating farm agro-biodiversity using the Biodiversity Friend methodology • Targeting agricultural policies and interventions to serve multiple stakeholder goals: A new modeling approach using Bayesian Network models • A River Health Monitoring Framework for Myanmar: Methods and Tools • Characterization of farms in terms of proximity to the natural state and in terms of their contribution to landscape connectivity • A Knowledge brokering framework for integrated landscape management	3339 - With strong WLE/Bioversity support, the EAT Lancet Commission study is transforming international food system and dietary guidelines for health and sustainability 3339 - WLE/Bioversity influenced the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to focus on critical interdependencies of biodiverse ecosystems and food production

WLE Innovations

WLE recorded 32 innovations in MARLO between 2017 and 2019, ranging from 11 innovations for FP1 (RDL) to three innovations for FP4 (VCR). Most innovations in 2018 and 2019 were led by one of the CGIAR Centers. Two were led by external partners.

Figure 7. (a and b) WLE innovations by year



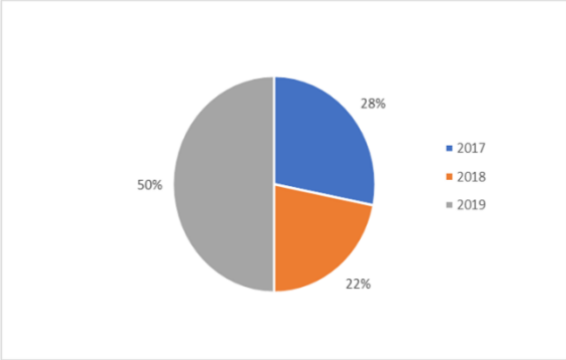
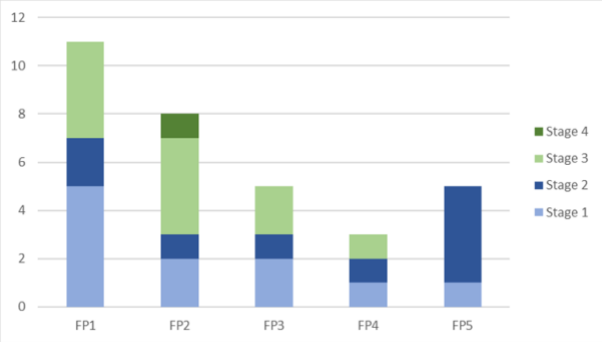
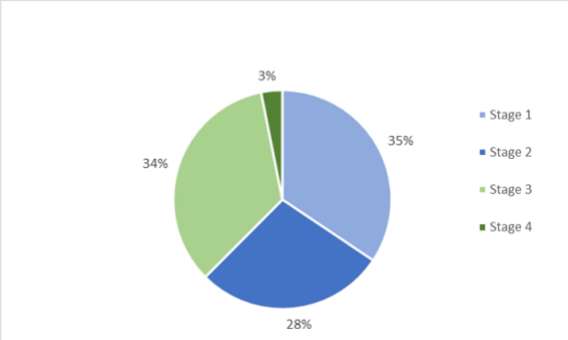


Figure 8. (a and b). WLE innovations by stage





Note on Innovation Stages (Source: CGIAR)

Stage 1: Discovery/proof of concept (PC - end of research phase). The innovation has completed the initial research phase. For policy research, this could include the identification and testing of policy options. For technologies and varieties, this means that the innovation has been tested under ideal or controlled conditions such as laboratory, greenhouse or confined settings (for example on-station).

Stage 2: Successful piloting (PIL - end of piloting phase). Not relevant for all innovations - The innovation has completed the piloting phase. The technology or practice has successfully completed broader testing under conditions intended to resemble those that the potential users of the new technology will encounter. The innovation has achieved a documented "real world" assessment of potential performance and feasibility. This may or may not mean that the innovation is immediately available for use

Stage 3: Available/ready for uptake (AV). The innovation is ready to be taken up by next users or end users. All conditions, such as licensing, certification, and regulatory approvals have been met so that end users (e.g. farmers, service providers) are able to use and disseminate the innovation legally. The category includes innovations made available for uptake in a previous year has increased its geographic scope (e.g., certification and release in a new country)

Stage 4: Uptake by next user (USE). The innovation has demonstrated uptake by next users. This includes any support for, or adoption by public, private or non-governmental institutions. It does not include uptake by end users (the underlying logic here is that next users are much easier to count/evidence, and that it would be very unusual to have uptake by end users at scale without involvement of any next users).

Figure 9. Distribution of innovations by region and FP

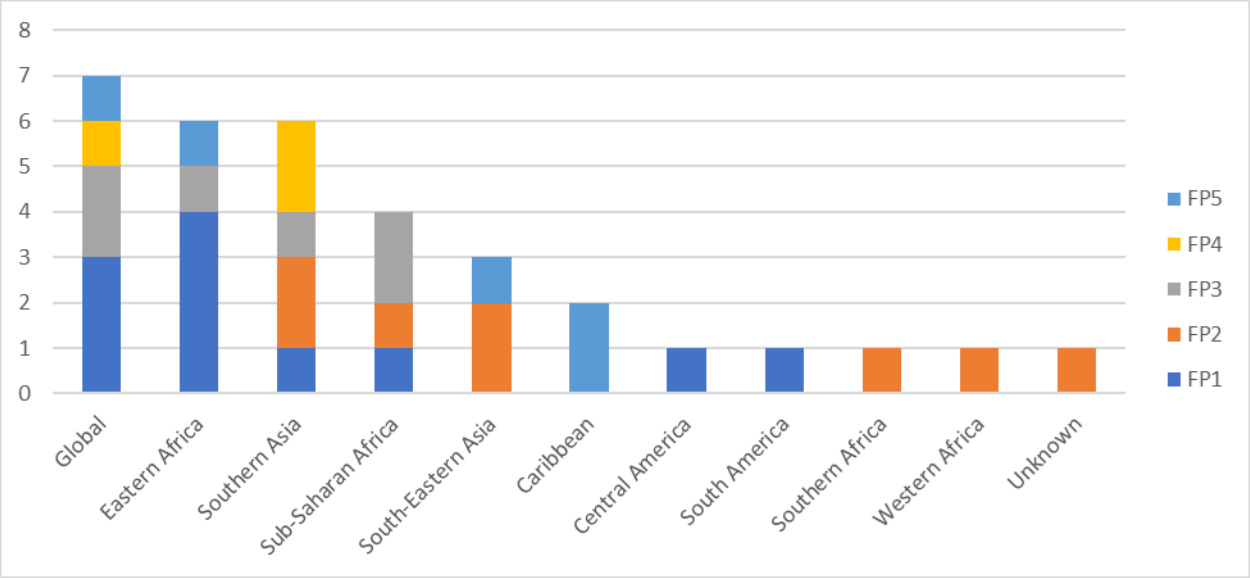
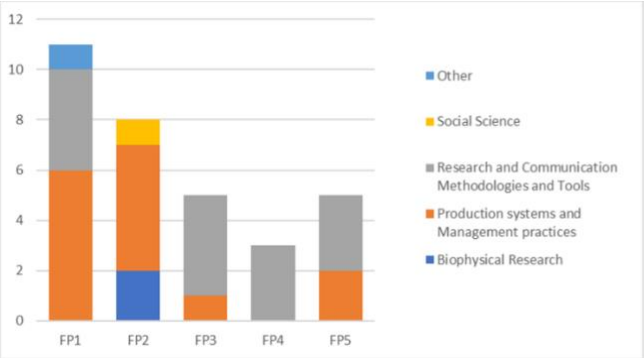


Figure 10. WLE innovations by type



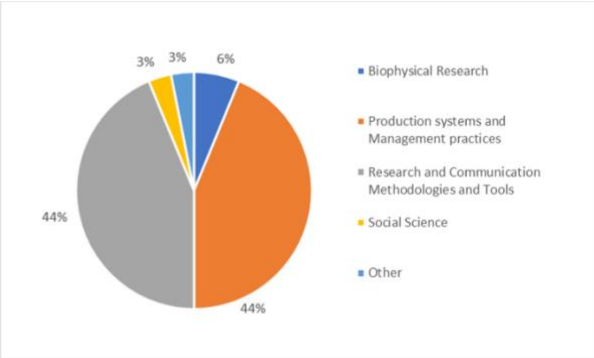


Table 11. Reported WLE innovations 2017–2019

Title	Year*	FRP & partner	Narrative	Innovation type	Stage	CRP role	Geographic scope
Silvopastoral systems for degrading lands in the Colombian Amazon	2017	FP1	The conventional silvopastoral systems, with high tree density, existing pastures, and non-native species, was modified by a system that includes native and alien species, improved pastures, trees dispersed or in barriers and short cycle crops.	Production systems & Management practices	1	Partial	National
Soil Data Manager	2017	FP1	A web application for evaluation and local adaptation of large-scale (open) soil maps.	Research & Communication Methodologies & Tools	2	Partial	Multi-national
Online water planning tool for Honduras	2017	FP1	*Not provided.*	Research & Communication Methodologies & Tools	3	Partial	National
Application of Big Data Analytics to Consolidate Fertilizer Trial Data into a Farmer-Support Tool	2019	FP1 CIAT	WLE/CIAT supported the Ministry of Agriculture to use new tools to organize the data sets into a useful decision-support tool. This innovative application of Big Data analytics has been adopted as Ministry policy. (OICR 3257)	Other	2	-	National
Re-configuring Community seed bank functions, by building on their social capital to incorporate landscape management and restoration	2019	FP1 Bioversity	This innovation is to reconfigure the functions of community seed banks in ways that they can serve more than one purpose, in this case landscape restoration and management and, in the future, nutrition. CSB represent a social capital which can be used for several purposes.	Production systems & Management practices	1	-	National
LandscapeCPR: Business model for landscape restoration in Makueni County, Kenya	2019	FP1 CIAT	This business model was selected as one of 8 finalists of the Climate Lab. LandscapeCPR is a farm development and asset management model where an asset manager develops investment opportunities for impact investors seeking financial, environmental, and social returns, at the same time operates equitably, transparently, and on a 'do no harm basis'.	Production systems & Management practices	1	-	National

Title	Year*	FRP & partner	Narrative	Innovation type	Stage	CRP role	Geographic scope
Cropping system sustainability tool 'CROSST' is an Excel-based tool assessing both agro-environmental and socio-economic impacts of Green Manure Cover Crop (GMCC) technologies	2019	FP1 CIAT	CROSST is an Excel-based tool assessing both agro-environmental and socio-economic impacts of Green Manure Cover Crop (GMCC) technologies. It has been piloted in Benin and Kenya.	Production systems & Management practices	3	-	Regional
Use of experimental games as a tool to help communities improve groundwater governance[1]	2019	FP1 IFPRI	WLE/IFPRI and PIM partnered with the Foundation for Ecological Security (FES), to develop and test the use of experimental games to strengthen groundwater governance. ICRISAT developed similar tools for managing surface water. These will be scaled out to over 3700 communities with some 245,000 households in six Indian states.	Production systems & Management practices	3	-	National
DATAR: a new application for Diversity Assessment Tool for agrobiodiversity and resilience	2019	FP1 Platform for agro-biodiversity Research	The Diversity assessment tool for agrobiodiversity and resilience (DATAR) tool allows local and national development organizations to integrate intra-specific crop, livestock and aquatic diversity into their decision-making plans to improve on farm productivity for small holder farmers.	Research & Communication Methodologies & Tools	1	-	Global
Global Soil Data Manager application	2019	FP1 CIAT	The Global Soil Data Manager enables monitoring carbon stocks and measuring soil health cost effectively. The Royal Swedish Academy of Engineering Sciences selected the GSDM application as a top 60 innovative idea.	Research and Communication Methodologies and Tools	1	-	Global
Soil-plant spectral diagnostic protocols for rapid and low-cost analysis of soil properties and plant nutrients using only light (infrared, x-rays)	2019	FP1 ICRAF	This rapid low cost of this technology allows soil and plant analysis to be conducted faster and at wider scales than was previously possible. This permits digital mapping of soil properties and measurement of nutrient constraints faced by different crops in multiple agronomic trials over large areas. It is also enabling soil and plant testing services to be delivered to smallholder farmers through handheld devices. (OICR 3337)	Production systems & Management practices	3	-	Global
Harnessing Ethiopian floodwaters helps dryland pastoralists and the approach is scaling up	2018	FP2 ICRSAT	Remote sensing tools used to identify flood-based spots for producing feed and food in about 1.2 million ha of land in Afar, Ethiopia. There is now an interest by other donors to do the same in flood-prone areas in Ethiopia and beyond. (OICR 2791)	Production systems & Management practices	3	Lead	Regional

Title	Year*	FRP & partner	Narrative	Innovation type	Stage	CRP role	Geographic scope
˜Contour bunding" preserves soils and boosts farmers' incomes by 20% in Mali - a new study	2017	FP2	In Mali contour bunding technique retained moisture and nutrients while preventing soil erosion also brings as much as 20% increase in net income. The technology reduces water runoff and controls soil erosion through ridges covered with perennial grasses such as Andropogon and Vetiver. Farmers use the ridges for crop production.	Production systems & Management practices	3	Partial	Regional
Designing low cost water harvesting system for Bundelkhand region and rejuvenating Haveli system	2017	FP2	To overcome water scarcity situation of Bundelkhand, traditional water harvesting system called as 'haveli system' need to be rejuvenated. A huge earthen bund to be constructed across the stream to join two adjacent hillocks/stream network to impound water during the monsoon.	Biophysical Research	1	Partial	Regional
Systems modelling (whole farm) as decision support evaluating impact of SLM strategies of household cashflows	2017	FP2	Whole-farm stochastic modelling approach allowed analysis of trade-offs and outcomes associated with potential farm systems change on simulated farms with varied cropping systems in five selected districts. It provides contrasting outcomes in terms of farm household's cash flows considering modern inputs, labor and market price.	Production systems & Management practices	1	Partial	Regional
Collective action games to strengthen resource governance	2017	FP2	*None provided. Level 4 innovations are expected to be associated with an OICR but no link has been provided / there is no apparent match for this 2017 innovation.*	Social Science	4	Lead	National
Developing government capacity in geospatial tools for land water analysis in Myanmar, enabling rice crop flood-damage prevention measures	2019	FP2 IWMI	The geo-spatial maps developed enables the Department of Agriculture in Myanmar, for the first time, to take measures to minimize flood damage to rice crops based on up-to-date data. The maps replace manually developed mapped dating several decades ago.	Biophysical Research	3	-	National
Application of new tool to map the economic and environmental suitability of solar irrigation in sub-Saharan Africa[2]	2019	FP2 IWMI	Suitability of solar irrigation mapping tool tested in Mali, Ethiopia, and Ghana, rolling out for sub-Saharan Africa. The tool enables mapping of areas suitable for solar irrigation based on a combination of natural resource, environmental and economic data.	Production systems & Management practices	2	-	Regional
Guideline on setting up Water User Associations and supporting institutions in pump-based irrigation schemes in Myanmar	2019	FP2 IWMI	A guideline was developed explaining a step wise approach in setting up appropriate institutional structures in pump-based irrigation schemes throughout the Central Dry Zone of Myanmar.	Production systems & Management practices	3	-	National

Title	Year*	FRP & partner	Narrative	Innovation type	Stage	CRP role	Geographic scope
WABEF, a toolkit to promote anaerobic digestion of bio-wastes in West Africa	2018	FP3 CIRAD	WABEF is a compendium of data sheets and databases to estimate the wastes from agricultural activities, municipal activities, and ago-industrial activities. It suggests anaerobic digestion technologies to use up bio-wastes. It uses a simulation model to compare mass balances and assess the investment and operating costs of these technologies to support decision making by governments, communities, industries and farmers.	Production systems & Management practices	3	Partial	Regional
Fecal Sludge Management Business Model Tool	2018	FP3 IWMI	The planning toolkit has tools to assist with stakeholder engagement, infrastructure planning and selection of business models.	Research and Communication Methodologies and Tools	1	Lead	Regional
Resource Recovery and Reuse business models have been incorporated into curricula of 8 universities in 6 countries	2019	FP3 IWMI	Curricula on resource recovery and reuse business models that were incorporated into graduate programs in the 2019-2020 academic year at eight universities in six countries.	Research & Communication Methodologies & Tools	3	-	Global
Assessment of City Region Food System toolkit (RUAF/FAO)	2019	FP3 RUAF	The toolkit provides guidance on assessing and building sustainable city region food systems (CRFS). It supports defining and mapping a city region; collecting data on CRFS; and using a multistakeholder process to engage policymakers and other stakeholders to design a more sustainable and resilient CRFS.	Research & Communication Methodologies & Tools	1	-	Global
Milan Urban Food Policy Pact (MUFPP) Indicator Framework with gender lens, field tested in Nairobi	2019	FP3 Mazingira Institute	A methodology to assess food system resilience through a gender lens as a basis for identifying ways to strengthen resilience as a means to implement the "Milan Urban Food Policy Pact".	Research & Communication Methodologies & Tools	2	-	National
A Mobile Phone App that will provide more than half of Indian farmers with crop insurance in the next 2-3 years.	2018	FP4 IWMI	Satellite and climate data, combined with field data on crop yields, AgRISE delivers a crop health card, which enables insurers and government agencies to estimate crop damage and overall insured losses quickly and reliably for all of India's major crops. Based on the latest geospatial technology (Google Earth Engine and Open Data Kit for field data collection), the tool will strengthen implementation of PMFBY [government sponsored crop insurance scheme], reducing costs and facilitating the process.	Research & Communication Methodologies & Tools	1	Sole	National

Title	Year*	FRP & partner	Narrative	Innovation type	Stage	CRP role	Geographic scope
Mobile data entry for manual data	2017	FP4	We developed Google Forms based online data entry app that our field assistants have been using to provide manually measured daily discharge data. Previously manual data was only available after 4-6 months because data was only recorded in data registers that had to be transported to and transcribed in Kathmandu.	Research & Communication Methodologies & Tools	3	Partial	Sub-national
Framework to assess data exchange in transboundary waters	2019	FP4 IWMI	A new framework for assessing the strength of data exchange in transboundary waters was applied (or piloted) in 25 river basins. It provides a measure of the level of data sharing among riparian countries.	Research and Communication Methodologies and Tools	2		Global
Evaluating farm agro-biodiversity using the Biodiversity Friend methodology	2018	FP5	*Not provided.*	Research & Communication Methodologies & Tools	2	-	National
Targeting agricultural policies and interventions to serve multiple stakeholder goals: A new modeling approach using Bayesian Network models	2018	FP5 ICRAF	Holistic probability modeling approach using Bayesian Network models combined with participatory engagement to identify how to make agricultural policies and interventions more nutrition-sensitive.	Research & Communication Methodologies & Tools	2	Partial	National
A River Health Monitoring Framework for Myanmar: Methods and Tools	2018	FP5 IWMI	The Myanmar Healthy Rivers Initiatives method was applied to 2 rivers (Ayeyarwady and Thanlwin) to variables such as: flow stress, biodiversity indicators, water quality results based on magnitudes of threats.	Research & Communication Methodologies & Tools	2	Lead	National
Characterization of farms in terms of proximity to the natural state and in terms of their contribution to landscape connectivity	2017	FP5	A series of field studies have been carried out by surveying several aspects such as biodiversity, agricultural practices, environmental quality and cultural aspects. The outcome of this study will be a classification of farms that contribute more to structural landscape connectivity.	Production systems & Management practices	2	Sole	National
A Knowledge brokering framework for integrated landscape management	2019	FP5 Bioversity	The framework was developed based on an extensive global literature review of opportunities and challenges in delivering decision support at landscape scale and of factors and conditions that can bring about more effective responses to decision support. A decision-support tool was developed to assess tradeoffs among intervention options.	Production systems & Management practices	1	-	Global

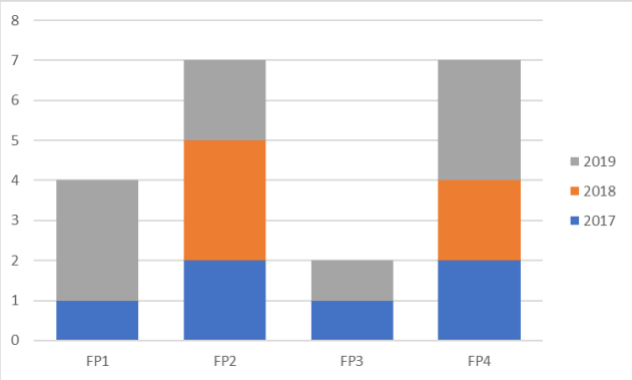
1. In 2019 the innovation was reported under FP1, and the associated OICR under FP4. IFPRI also runs much of its experiential games work under FP4 and there are some elements (ICRISAT) that take place under FP2.

2. Solar work straddles FP2 and FP4 but the innovation in 2019 was reported under FP2

WLE Policies

WLE recorded 20 polices in MARLO between 2017 and 2019, with the greatest number contributed by FP2 and FP4 (VCR), each with seven policies. FP5 did not report any policies during its reduced (two-year) period of operations.

Figure 11 (a and b). Distribution of policies by FP and year



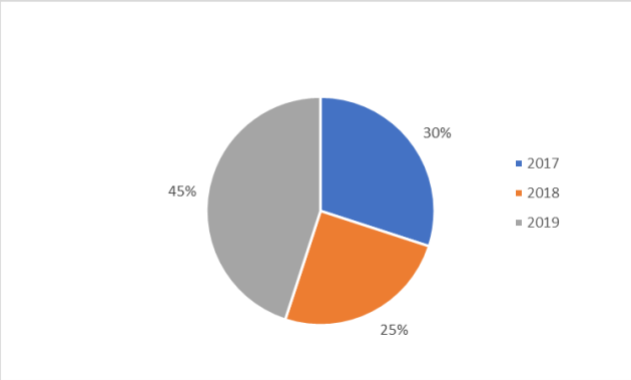
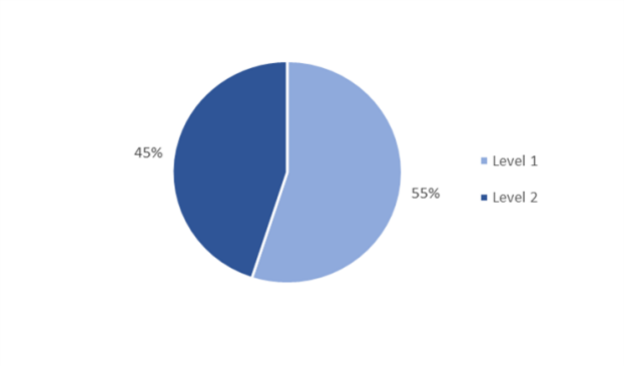


Figure 12 (a and b). Distribution of policies by FP and year



Note on Policy Levels (Source: CGIAR)

Level 1: Research taken up by next user (decision maker or intermediary) = Level 1 of outcome/impact case

Level 2: Policy/law etc. enacted = Level 2 of Outcome/impact Case

Level 3: Evidence of impact on people and/or natural environment of the changed policy or investment = Level 3 of Outcome/impact case

Note the definition of the stages changed from 2017 to 2018/2019. Stage 1 and Stage 2 were used in 2017. Level 1, 2 and 3 were used in 2018–2019. In this analysis Stage 1 and Stage 2 have been aggregated with Level 1 and Level 2 respectively.

Figure 13. Distribution of policies by region and FP

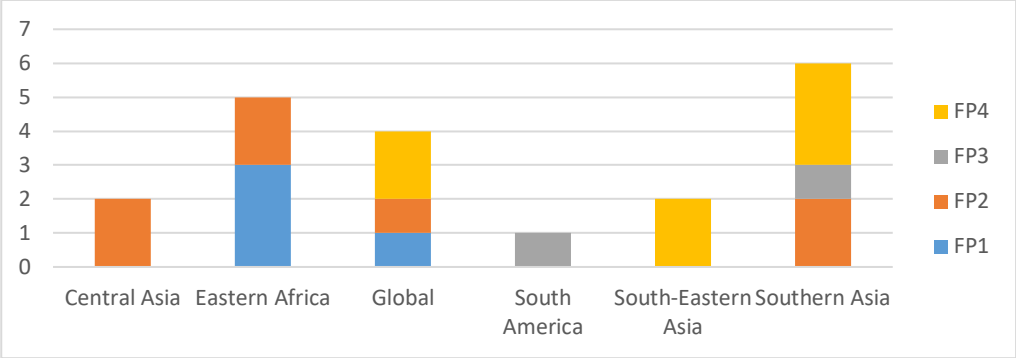


Table 12. Reported WLE policies 2017–19

ID Dashboard	Title	FP	Year	Policy investment type	Level	Geographic scope	Policy owner	Strategy & Results Framework (SRF) Sub-IDO
386	Revised Ethiopian Soil Strategy which includes soil fertility management measures that will contribute to reducing soil degradation	FP1	2017	Policy or Strategy	Level 2	National	-	-
163	WLE/Bioversity International support for development of new National Seed Policy aimed at agricultural transformation in Uganda	FP1	2019	Policy or Strategy	Level 1	National	Public Sector	Appropriate regulatory environment for food safety Reduced market barriers
169	Support of adoption of the Government of Ethiopia's Soil and Agronomic Data Sharing Policy **(OICR 3257**)	FP1	2019	Policy or Strategy	Level 2	National	Public Sector	Closed yield gaps through improved agronomic and animal husbandry practices
164	Recommendations on soil carbon management and monitoring accepted by the United Nations Convention to Combat Desertification (UNCCD) Conference of the Parties	FP1	2019	Policy or Strategy	Level 1	Global	Other	Land, water and forest degradation (Including deforestation) minimized and reversed
385	The Ethiopian Prime Minister approved a policy to make all water technologies tax exempt. This tax exemption aims to encourage the adoption of agricultural water technologies such as solar irrigation.	FP2	2017	Policy or Strategy	Level 2	National	-	-
387	Design of new investments by Government of India in grid connected solar pumps for irrigation, with surplus power buy-back arrangements (US$7,000M)	FP2	2017	Budget or Investment	Level 1	National	-	-
82	Based on the demonstrated proof of concept of water spreading to manage extreme flooding across pastures in Afar state, eastern Ethiopia, supported by WLE, the approach is being integrated into a major World Bank/ International Fund for Agricultural Development project **(OICR 2791)**	FP2	2018	Budget or Investment	Level 2	National	Public Sector	Agricultural systems diversified and intensified in ways that protect soils and water

ID Dashboard	Title	FP	Year	Policy investment type	Level	Geographic scope	Policy owner	Strategy & Results Framework (SRF) Sub-IDO
83	Indian and Gujarat state governments rolling out national solar irrigation investment program based on results of WLE and CCAFS-supported pilot study. Farmers will be able to sell surplus power to electric utility **(OICR 2792)**	FP2	2018	Budget or Investment	Level 2	National	Public Sector	Reduced smallholders' production risk
84	Based on a WLE-supported evaluation of the effectiveness of an irrigation management training program in Tajikistan, the United States Agency for International Development re-designed the program to target women, who are increasingly taking responsibility for management of the irrigation systems **(OICR 2773)**	FP2	2018	Policy or Strategy	Level 2	National	Funder	Reduced smallholders' production risk
219	Uzbekistan agricultural development strategy	FP2	2019	Policy or Strategy	Level 1	National	Public Sector	Agricultural systems diversified and intensified in ways that protect soils and water
223	WLE/ IFPRI research feeds into World Bank Guidance on irrigation-nutrition linkages	FP2	2019	Policy or Strategy	Level 1	Global	Funder	Increased availability of diverse nutrient-rich foods
389	The Sri Lankan cabinet approval of the new National Sanitation Policy of Sri Lanka	FP3	2017	Policy or Strategy	Level 2	National	-	-
220	Municipal food security policy for a more integrated food security plan for the Cali urban region (Colombia)**(OICR 3363)**	FP3	2019	Policy or Strategy	Level 2	Sub-national	Public Sector	-
388	Design of new investments by Government of India in groundwater irrigation (US$400M) in irrigation-deprived districts	FP4	2017	Budget or Investment	Level 1	National	-	-
384	The United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties formally recognized that increasing soil organic matter puts carbon back into the soil and hence can help mitigate climate change	FP4	2017	Policy or Strategy	Level 2	Global	*Not requested*	-

ID Dashboard	Title	FP	Year	Policy investment type	Level	Geographic scope	Policy owner	Strategy & Results Framework (SRF) Sub-IDO
86	Supported by WLE and CCAFS, the South Asia Drought Monitoring System is being used by the Indian government to make cropping recommendations to farmers, target drought relief efforts and develop district contingency plans **(OICR 2796)**	FP4	2018	Policy or Strategy	Level 1	National	Funder	-
85	A WLE-supported methodology for monitoring environmental water flows for Sustainable Development Goal 6.4.2 has been adopted and disseminated by the United Nations for use in country reporting against the SDG Goal (**OICR 2795)**	FP4	2018	Policy or Strategy	Level 2	Global	Other	Land, water and forest degradation (Including deforestation) minimized and reversed Enhanced conservation of habitats and resources
217	Availability models and tool for irrigation planning incorporated into Nepal's National Irrigation Master Plan **(OICR 3360)**	FP4	2019	Policy or Strategy	Level 2	National	Public Sector	-
221	Laos national groundwater action plan and irrigation strategy & revised water resources law **(OICR 3364)**	FP4	2019	Policy or Strategy	Level 2	National	Public Sector	-
222	The Vietnam Ministry of Agriculture and Rural Development has endorsed the policy recommendations on managed aquifer recharge (MAR) as a new agricultural extension tool	FP4	2019	Policy or Strategy	Level 1	National	Public Sector	-

WLE OICRs

WLE recorded 20 OICRs between 2017 and 2019 (Table 13).

Figure 14: Consideration of Cross Cutting Issues in WLE OICRs, 2017–2019

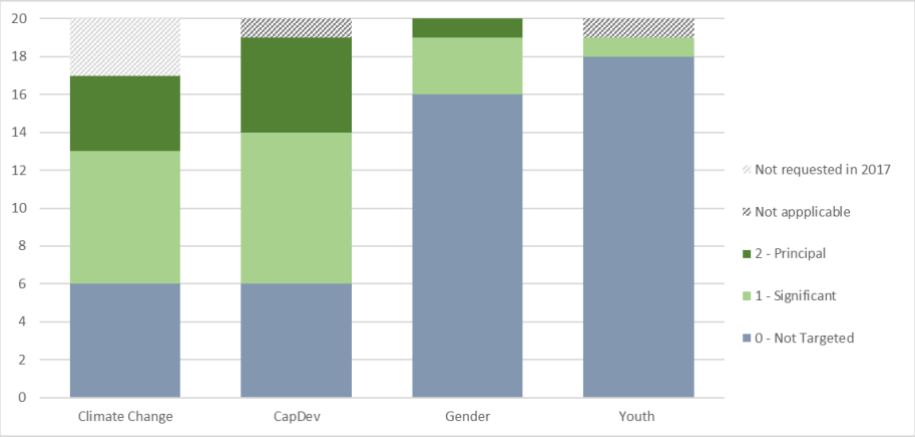


Figure 15: Representation of External Partners in WLE OICRs, 2017–19

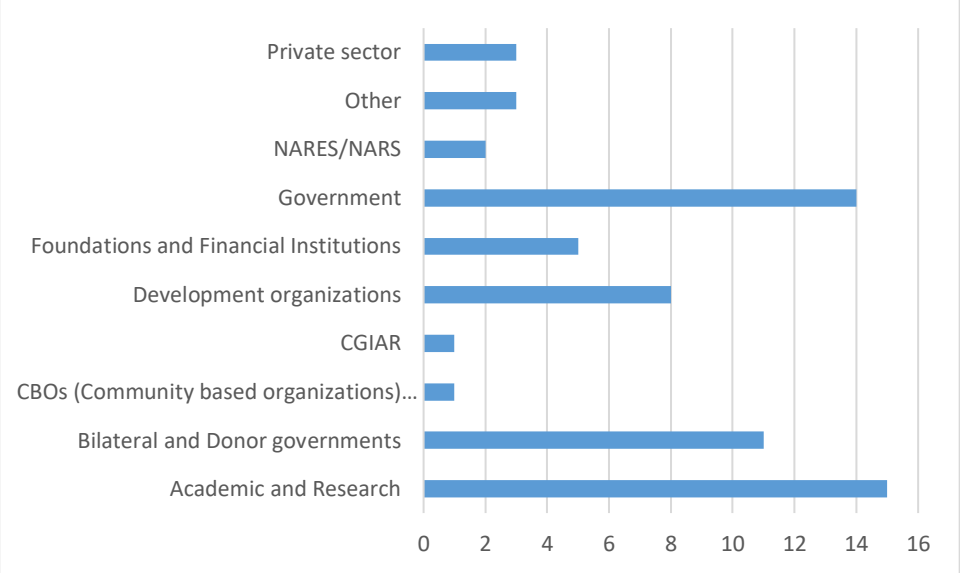


Table 13. WLE OICRs 2017–19

Case No.	Name	FP	Center	Sub IDO with reference to related SLO or CCI	Year	Maturity of change	Synopsis - Outcome/impact statement
2205	Evidence-based soils agronomy for raising crop production in Africa	FP1 (RDL)	ICRAF	**SLO-3:** Land, water and forest degradation (Including deforestation) minimized and reversed	2017	2	A growing suite of innovative low-cost decision-support tools and soil datasets produced by ICRAF and its partners through the Africa Soil Information Service (AfSIS) are being used by 14 African governments and other investors to map soil properties and measure crop nutritional responses to different soil management regimes. These technologies are guiding the sustainable restoration of degraded lands and have results in the development of several state-of-the-art national soil information systems (in Ethiopia, Ghana, Nigeria, and Tanzania).
2794	Soil-plant spectral technology guiding soil fertility investments in Africa (WLE-ICRAF)	FP1 (RDL)	ICRAF	**SLO-3:** Land, water and forest degradation (Including deforestation) minimized and reversed	2018	**2**	Seventeen African countries are now using soil–plant spectral technology developed by CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners to restore soils and boost agricultural production. The Africa Soil Information Service (AfSIS) is now being deployed for targeting soil fertility restoration strategies. Ethiopia, Ghana, Nigeria, and Tanzania have established state-of-the-art soil information systems based on the technology. NGOs and the private sector are delivering soil testing services to smallholder farmers and monitor intervention impacts on soil health.
2793	Water planning system "Agua de Honduras" used to improve Honduran investment decisions (WLE-CIAT)	FP1 (RDL)	CIAT	**SLO-3:** Increased resilience of agro-ecosystems and communities, especially those including smallholders **CCI P&I**: Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research	2018	**2**	The Government of Honduras piloted and adopted a major new data platform, "Agua de Honduras" that provides data on hydrology, vegetative cover, soil properties, along with future climate scenarios. Implemented by the Centro Internacional de Agricultura Tropical (CIAT) and contributing to the CGIAR Research Program on Water, Land and Ecosystems (WLE), the platform has been aiding water management decisions, including being used 150 times to identify rainwater harvesting sites and influencing at least one local land investment decision.

Case No.	Name	FP	Center	Sub IDO with reference to related SLO or CCI	Year	Maturity of change	Synopsis - Outcome/impact statement
3257	New Ethiopian Ministry of Agriculture data sharing policy supported by WLE/CIAT and GIZ to improve food production while building landscape health	FP1 (RDL)	CIAT	**CCI Climate:** Reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use (Mitigation and adaptation achieved) **CCI P&I:** Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research	2019	2	WLE/CIAT, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and partners supported the Ethiopian Ministry of Agriculture to adopt a comprehensive data sharing policy. Currently, data sets, for example fertility trials, are scattered among many scientists and institutions, severely limiting the ability to target fertilizer recommendations to farmers. This will now change as the Ministry is working with stakeholders to collate datasets to develop national fertilizer recommendations. This policy will undoubtedly support the agricultural transformation agenda.
3337	WLE/ICRAF soil spectral technology impacting soil restoration strategies and investments are being scaled up from Africa to global use	FP1 (RDL)	ICRAF	**CCI P&I:** Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research	2019	2	WLE/ICRAF's soil spectroscopy initiatives have moved from African outcomes to achieving global outcomes. Growing donor interest in deploying low-cost soil spectral technology in agricultural projects for better evidence-based investments is leading to major investments in India, Haiti, and elsewhere. WLE and the Food and Agriculture Organization-led Global Soil Laboratory Network are leading a new initiative to develop a free global soil mid-infrared spectral library and prediction service in collaboration with the Kellogg Soil Survey Laboratory in the United States
2204	Ethiopia adopts WLE research findings to improve the returns on its massive investments in soil and water management	FP1 (RDL) & FP2 (LWS)	ICRISAT & CIAT	**SLO-3:** Land, water and forest degradation (Including deforestation) minimized and reversed **CCI P&I:** Conducive agricultural policy environment	2017	1	In 2017, the Prime Minister approved a policy to make all agricultural water technologies tax exempt. Ethiopia also adopted a new Soils Strategy to target soil fertility management interventions in various landscape niches; and the Sustainable Land Management Program (SLMP) began adopting new implementation interventions at different landscape levels following community-led processes. These outcomes are a direct result of WLE research, capacity strengthening and policy engagement. Together, they can greatly enhance the impacts of agricultural investments.

Case No.	Name	FP	Center	Sub IDO with reference to related SLO or CCI	Year	Maturity of change	Synopsis - Outcome/impact statement
2792	A revolution in solar-powered Irrigation: Solar Power as Remunerative Crop (SPaRC) model is being scaled out nationwide in India (WLE-IWMI)	FP2 (LWS)	IWMI	**SLO-1:** Reduced smallholders production risk	2018	1	A cooperative business model developed by the CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners is now formally confirmed as one of four components of a total USD 16.4 billion Indian Government farm energy program (KUSUM). Gujarat state has begun scaling out the concept; six other states have begun piloting it under KUSUM. In the model, cooperatives manage a small solar-powered grid for irrigation pumps that sell surplus power to the electric utility.
2773	Evaluation of a water management training program in Tajikistan leads to redesign to target women farmers and informs Feed the Future Learning Agenda (WLE-IWMI)	FP2 (LWS)	IWMI	**SLO-1:** Reduced smallholders production risk **CCI:** Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	2018	2	United States Agency for International Development (USAID) re-oriented an irrigation investment in Tajikistan to include women, based on results of a study by the CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners. The study evaluated the effectiveness of a water management training program. While the training is indeed effective in improving crop and water management, women were excluded from training despite their growing role in water management, as men migrate away and out of farming.
2791	Harnessing Ethiopian floodwaters helps dryland pastoralists – and the approach is being scaled up (WLE-ICRISAT)	FP2 (LWS)	ICRISAT	**SLO-3:** Agricultural systems diversified and intensified in ways that protect soils and water	2018	1	The government of Afar state, Ethiopia, has adopted a landscape-level water spreading approach demonstrated by the CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners in dry lowland areas. The approach reduces destruction from flooding and spreads water across pastures and cultivated fields, increasing their productivity. This approach has been integrated into a proposed project supported by the World Bank and International Fund for Agricultural Development.
3348	Building community prosperity through scaling out WLE/ICRISAT agricultural water management interventions for sustainable crop intensification in Central India	FP2 (LWS)	ICRISAT	**SLO-1:** Reduced smallholders production risk	2019	2	Water harvesting and productivity interventions implemented by WLE/ICRISAT and the Central Agroforestry Research Institute on a pilot watershed in central India had significant impacts on water resources, incomes and farmers' livelihoods. As a result, the Government of Uttar Pradesh has asked ICRISAT and a consortium of national partners to scale the model out to over 35,000 ha.

Case No.	Name	FP	Center	Sub IDO with reference to related SLO or CCI	Year	Maturity of change	Synopsis - Outcome/impact statement
3362	WLE/ICRISAT integrates smart water management tools and Innovation Platforms in small-scale Zimbabwean irrigation schemes to deliver enhanced water productivity, incomes, and conflict reduction	FP2 (LWS)	ICRISAT	**SLO-3:** Agricultural systems diversified and intensified in ways that protect soils and water	2019	2	The combined use of Agricultural Innovation Platforms and smart water management tools in two small-scale communal irrigation schemes in Zimbabwe, resulted in major improvements in water and land productivity, household incomes, and reductions in conflict levels. As a result, the Director of Irrigation with support from the Australian Council for International Agricultural Research (ACIAR) agreed to fund a second project that is extending the model to 30 more irrigation schemes, covering 757 ha and 1698 farmers.
2206	Sri Lankan sanitation policy adopts recycling of septage for reuse as fertilizer	FP3 (RUL)	IWMI	**SLO-3:** Land, water and forest degradation (Including deforestation) minimized and reversed	2017	2	In 2013, the Government of Sri Lanka requested IWMI's support on septage management, which was then a gap in the newly drafted National Sanitation Policy. The final policy, formally approved by the Cabinet in late 2017, mainstreams septage management and supports safe resource recovery and reuse based on IWMI-related research.
3363	WLE/CIAT facilitated development and approval of the first municipal food security policy for Cali (Colombia) to support an integrated action plan	FP3 (RUL)	CIAT	**CCI P&I:** Conducive agricultural policy environment	2019	2	As a result of CIAT/WLE efforts since 2015, in 2019 the City of Cali, Colombia, adopted a comprehensive municipal food security policy. It emerged from research and consultations among multiple stakeholders and is designed to improve the food security of the poorest consumers in Cali and surrounding regions. Workshops with other municipalities is likely to assist them to adopt a similar plan.
2795	Environmental water flows go global to support implementation of the Sustainable Development Goals (SDGs) (WLE-IWMI)	FP4 (VCR)	IWMI	**SLO-3:** Land, water and forest degradation (Including deforestation) minimized and reversed	2018	2	CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners have been leading efforts to include environmental flows (e-flows) in the SDG Indicator 6.4.2 on water stress. WLE led the preparation of a guideline to support countries' reporting on e-flows. This methodology is being distributed by the Food and Agriculture Organization of the United Nations (FAO) to all countries to monitor progress on SDG 6.4 on alleviating water scarcity.

Case No.	Name	FP	Center	Sub IDO with reference to related SLO or CCI	Year	Maturity of change	Synopsis - Outcome/impact statement
2796	Making the leap from drought monitoring to managing agricultural drought risks in India (WLE-IWMI)	FP4 (VCR)	IWMI	**CCI Climate:** Enhanced capacity to deal with climatic risks and extremes (Mitigation & adaptation achieved) **SLO-3:** Enhanced adaptive capacity to climate risks (More sustainably managed agro-ecosystems)	2018	1	The South Asia Drought Monitoring System (SADMS), created by the CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners, provided real-time drought severity data at micro-level to three Indian districts. The crop yields and incomes in these areas were significantly higher than in the control areas. As a result, the Indian government, and World Bank plan to scale out the model.
3226	Experiential games developed by WLE/PIM/IFPRI/ICRISAT are being scaled out to almost 250,000 households to improve ground and surface water governance in India	FP4 (VCR)	IFPRI / ICRISAT	**CCI CapDev:** Increased capacity for innovation in partner development organizations and in poor and vulnerable communities **SLO-3:** More productive and equitable management of natural resources	2019	2	Rapid decline in groundwater levels is a serious challenge in many areas in India. WLE/IFPRI and PIM partnered with the Foundation for Ecological Security (FES), a major Indian NGO, to develop and test the use of experiential games to strengthen groundwater governance. ICRISAT developed similar tools for managing surface water. These tools were so successful that they will now be scaled out to over 3700 communities involving some 245,000 households in at least six Indian states.
3360	Nepal's National Irrigation Master Plan adopts WLE/IWMI water availability calculations and tools	FP4 (VCR)	IWMI	**CCI Climate:** Enhanced capacity to deal with climatic risks and extremes (Mitigation and adaptation achieved)	2019	2	Nepal's Department of Water Resources and Irrigation (DWRI) has incorporated into its new National Irrigation Master Plan hydrological models of four river basins and a desktop tool for Environmental Flows (E-flows) assessment developed by IWMI. This is the first time irrigation planning is based on hydrological modeling of entire river basins to account for upstream/downstream linkages and multiple water uses, and the first-time assessment of E-flows are included. It will transform future irrigation planning in Nepal.

Case No.	Name	FP	Center	Sub IDO with reference to related SLO or CCI	Year	Maturity of change	Synopsis - Outcome/impact statement
3364	WLE/IWMI research and capacity building to support sustainable groundwater development and management in Laos influences policies and implementation programs	FP4 (VCR)	IWMI	**SLO-3:** More productive and equitable management of natural resources	2019	2	Research carried out by WLE/IWMI supported by the Australian Centre for International Agricultural Research (ACIAR) has had significant influence on groundwater management policies and practice in Laos. Laos adopted specific recommendations of the research for its national groundwater action plan, scaled out piloted sub-national groundwater management plans to other areas, used research results as inputs to a revised law on water resources, and included research findings in the draft national groundwater irrigation strategy.
3339	With strong WLE/Bioversity support, the EAT Lancet Commission study is transforming international food system and dietary guidelines for health and sustainability	FP5 (ESA)	Bioversity	**CCI CapDev:** Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	2019	1	With four senior scientist co-authors, the CGIAR was a major contributor to the EAT-Lancet Commission's ground-breaking comprehensive review defining a universal healthy diet. It also shows how agriculture, currently the primary cause and victim of environmental degradation, is also our best bet for solving hunger, health and sustainability. The report is having a profound influence on the international development discourse and has set the stage for the work of the WLE Commission on the Sustainable Intensification of Agriculture.
3338	WLE/Bioversity influenced the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to focus on critical interdependencies of biodiverse ecosystems and food production	FP5 (ESA)	Bioversity	**CCI CapDev:** Increased capacity for innovation in partner development organizations and in poor and vulnerable communities	2019	1	Building on its scientific work, WLE influenced the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) to focus on the critical interdependencies of biodiverse ecosystems and food production. The 134 IPBES countries have adopted WLE's proposal to focus its Nexus Assessment on Biodiversity, Food, Health and Water. It will identify nature-based solutions integrating agriculture and biodiversity to support both human health and environmental sustainability. WLE is positioned as a principal contributor to agricultural policy developments in the next decade.

Annex 8: Analysis of OICRs

This Annex presents findings on the three OICRs that were examined in depth during the Review

WLE 2205: Evidence-based soils agronomy for raising crop production in Africa		
WLE		
Phases of report (new/updated same level/updated new level of maturity): New		
If for Innovations at Level 4 or Policies at Levels 2 and 3: No		
Year reported: 2017	Maturity level: 2	# Years of programmatic work: WLE/ICRAF has supported work on soil spectroscopy since 2012 *(Source: OICR 3337)*
Follow on OICRS (Updated at same level of maturity): • WLE 2794: Soil-plant spectral technology guiding soil fertility investments in Africa (2018) • WLE 3337: WLE/ICRAF soil spectral technology impacting soil restoration strategies and investments are being scaled up from Africa to global use (2019)		
Geographic location(s): Global		
Populations covered, estimated size and socio-demographic categories (e.g., subsistence farmers, women, adolescents, etc.) • Decision-support tools and soil datasets produced by ICRAF and its partners through the Africa Soil Information Service (AfSIS) are being used (in 2017) by 14 African governments and other investors to map soil properties and measure crop nutritional responses to different soil management regimes.		
Key contributors to the outcome		
• CGIAR (other CRPs, Platforms, FPs, centers): ICRAF		
External partners list in the OICR (2017–2019): • ISRIC - International Soil Reference and Information Centre Corporation • Rothamsted Research • The Earth Institute, Columbia University		
Links to the CGIAR Strategic Results Framework: (IDOs and sub-IDOs) • IDO: Natural capital enhanced and protected, especially from climate change • Sub-IDO 3.1.1 Land, water and forest degradation (Including deforestation) minimized and reversed		
WLE contributions to the outcome *(list any of the following)*		
Innovations: • None in 2017/none directly associated with OICR 2205. • The 2018 OICR refers to development and testing of a prototype of a low cost, handheld, near infrared spectrometer for developing countries was developed in partnership with Global Good (a collaboration between Bill Gates and Intellectual Ventures). • The 2019 OICR is associated with a related 2019 WLE Level 3 innovation entitled 'Soil-plant spectral diagnostic protocols for rapid and low-cost analysis of soil properties and plant nutrients using only light (infrared, x-rays).		
Policies: No MARLO links to policies for the period 2017-2019 • Africa Soil Information Service AfSIS and TanSIS have generated maps of areas requiring liming in Tanzania. These are being used for planning investments by the Ministry of Agriculture and the Bill & Melinda Gates Foundation (BMGF).		
Key CRP publications supporting the OICR: Gourlay, S., Aynekulu, E., Carletto, C., & Shepherd, K. (2017). Spectral Soil Analysis Household Surveys: A Guidebook for Integration. https://hdl.handle.net/10568/99331 Hengl T.; Leenaars, J.G.B.; Shepherd, K.D.; Walsh, M.G.; Heuvelink, G.B.M.; Mamo, T.; Tilahun, H.; Berkhout, E.; Cooper, M.; Fegraus, E.; Wheeler, I.; Kwabena, N.A. 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. https://link.springer.com/content/pdf/10.1007/s10705-017-9870-x.pdf. DOI 10.1007/s10705-017-9870-x. (Accessed 1200 times on CGSPACE database). Johnson, J.-M., Vandamme, E., Senthilkumar, K., Sila, A., Shepherd, K. D., & Saito, K. (2019). Near-infrared, mid-infrared or combined diffuse reflectance spectroscopy for assessing soil fertility in rice fields in sub-Saharan Africa. GEODERMA, 354. https://doi.org/10.1016/j.geoderma.2019.06.043		

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Tittonell, P.; van Dis, R.; Vanlauwe, B.; Shepherd, K. 2015. Managing Soil Heterogeneity in Smallholder African Landscapes Requires a New Form of Precision Agriculture. In: Lal, R and Stewart, B.A. (eds) Soil-Specific Farming: Precision Agriculture. Advances in Soil Science, CRC Press. Pages 199-224. http://www.crcnetbase.com/doi/abs/10.120/b18759-9
WLE. (2020). Soil-plant spectral technology guiding soil fertility investments in Africa (WLE-ICRAF) (Vol. 14).

- **OICR relationship with CGIAR cross-cutting issues**

Capacity development – YES - 1 – significant. Capacity development and advisory services have been provided to 14 African countries as well as China, Peru, and India including their participation in the New global spectral library initiative. A guidebook (Gourlay et al. 2017) is intended to be a reference for survey practitioners looking for guidance on integrating soil health testing in household and farm surveys.

Climate change – NA in 2017. The work on soil Carbon monitoring has important application for climate change mitigation and carbon sequestration payments to local communities – linked to the SDGs and impact on the CCD i.t.o. soil C measurement

Gender – NO

Youth – NO

Key implementing organization (e.g. institute, partner)

- ICRAF

External partners related

- Earth Institute of Columbia University (AfSIS host) (USA)
- Rothamsted Research (UK)
- ISRIC — World Soil Information (Netherlands)
- Private sector partners – e.g., ISDA in Ghana
- Governments - 14 African governments and other investors to map soil properties and measure crop nutritional responses to different soil management regimes. Development of several state-of-the-art national soil information systems (in Ethiopia, Ghana, Nigeria, and Tanzania).
- U.S. Department of Agriculture and the Global Soil Laboratory Network of the Global Soil Partnership to develop a global soil property prediction service

Partnerships:

Partners in the further development of the Africa Soil Information Service (AfSIS) include

- Colombia University as host of AfSIS
- Rothamsted Research, which applied spectral techniques to historical soil samples from Africa, and
- Wageningen University which hosts the International Soil Reference and Information Centre (ISRIC), now known as World Soil Information.

Linking up with FoodAfrica, the Laboratory has helped 14 government institutions, three private sector labs, and advanced research centers, such as Rothamsted Research, adopt the technology and provided training in its use. AfSIS has helped develop state-of-the-art soil information systems based on spectral technology in Ethiopia (EthioSIS), Ghana (GhaSIS), Nigeria (NiSIS), and Tanzania (TanSIS – Ministry of Agriculture).

The updated 2018 and 2019 OICRs refer to a growing number of partners including foundations and financial institutions, governments, development organizations, academic and research bodies, and the private sector.

- The One Acre Fund established a rural spectral lab in Kenya
- Conservation International, Technoserve and The Nature Conservancy commissioned spectral analysis services
- The Bruker Corporation developed a commercial spectrometer that was subsequently modified to account for humidity based on further ICRAF research

- FAO as host of the Global Soil Partnership towards development of a global soil spectral library and prediction service
- Innovative Solutions for Decision Agriculture (iSDA), to collaborate with the private sector on a 30m resolution soil spectral map.

Building trust, sharing a common goal and ensuring legitimacy through producing quality science, has been a key element of effective partnerships.

Brief reviewer's description of the outcome (based on OICR report, documents cited, original data collected/interviews and other references)

The 2017 OICR concerns the development and utilization of state-of-the-art soil information systems at and related uptake and piloting of diagnostic spectral technology developed by ICRAF during the mid-2010s. ICRAF's Soil-Plant Spectral Diagnostics Laboratory and its partners developed soil-plant spectral diagnostics tools for rapid and low-cost analysis of soil properties and plant nutrients at georeferenced sites using light (infrared, x- rays). By 2017 that had enabled 14 countries to make more effective decisions on soil management and soil enhancement in several localities. AfSIS helped develop state-of-the-art soil information systems based on spectral technology in Ethiopia (EthioSIS), Ghana (GhaSIS), Nigeria (NiSIS), and Tanzania (TanSIS – Ministry of Agriculture). The results were being used for planning investments by the Ministry of Agriculture and the Bill & Melinda Gates Foundation covering over 85 million hectares in the four countries. New soil spectral data across sub-Saharan Africa were combined with legacy soil to create updated soil property maps of Africa at 250 resolution (SoilGrids). (OICR 2205)

The 2018 OICR focuses on growing utilization of the soil maps in Africa, notably by the World Soil Information organization to develop fertilizer recommendations for West Africa. Emphasis was placed on capacity building, from the household to national scales, and ICRAF provided training over a four-year period in the use of spectral methods for targeting land restoration: exposure training in the new methods to 1,059 people; intensive training to 178 people (30% women) from 17 countries; and support to 31 MSc/PhD students. Seventeen African countries were using spectral analysis technology in 2018; four countries established national digital soil information systems through the Africa Soil Information Service (AfSIS). The World Bank Living Standards Measurement Study piloted soil spectral technology in Ethiopia and Uganda. ICRAF provided advisory services to private companies now deploying spectral technology in 22 countries. (OICR 2794).

The 2019 OICR reports on growing donor and private sector interest in deploying soil spectral technology in agricultural projects, reflected in some USD 40 million in investment, and interest from new countries including India, Haiti and a further five countries in Africa. WLE was leading a new initiative of the FAO-led Global Soil Laboratory Network (GLOSOLAN) to develop a global soil mid-infrared spectral library and prediction service as a free resource to interested countries. WLE contributed to the design, testing and improvement of a low-cost handheld near infrared sensor. (OICR 3337)

Analysis

Mapping of the outcome to the CRP/Flagship ToC. How does it fit into the narrative of the ToC?

The work and results described in this OICR contribute to Outcome 3.1 of Flagship Project 1, Restoring Degraded Landscapes, namely, 'Strengthen approaches to the monitoring and evaluation of land restoration and the assessment of land degradation risks. There is a tangible contribution to the associated 2021 target, 'At least two tools in five countries being taken up and applied by 2021', with partner AfSIS having helped develop state-of-the-art soil information systems based on spectral technology in Ethiopia (EthioSIS), Ghana (GhaSIS), Nigeria (NiSIS), and Tanzania (TanSIS).

The capacity development work described in the 2018 OICR delivered the 2018 FP1 milestone, '60 national scientists (20% women) trained and supported in applying low-cost soil and plant health measurements using dry spectroscopy for targeting and monitoring land restoration in eight countries (Ethiopia, Ghana, Kenya, India, Malawi, Nepal, Nigeria, and Tanzania)'. Follow on work contributed the 2019 milestone, "Spectral-based soil information systems and Taking Agronomy to Scale Initiatives are scaled up to five additional African countries". One of the challenges highlighted during interviews was reconciling farmer's self-reported soil fertility assessments with scientific methods, and using the latter to calibrate the former, and triangulation to combine local knowledge with scientific measurements. At present the farmers' self-reported assessments are not sufficiently accurate and may result in yield losses. There is however potential for substantial efficiency gains related to quantity and timing on farming inputs bringing benefits to farmers and /or investors.

The work in this cluster is identified as contributing to the 'policies and institutions' cross cutting sub-IDO, *increased capacity of partner organizations, as evidenced by rate of investments in agricultural research.* The work with a wide cross section of partners reflects several of the impact pathways or strategies set out in the FP1 theory of change.

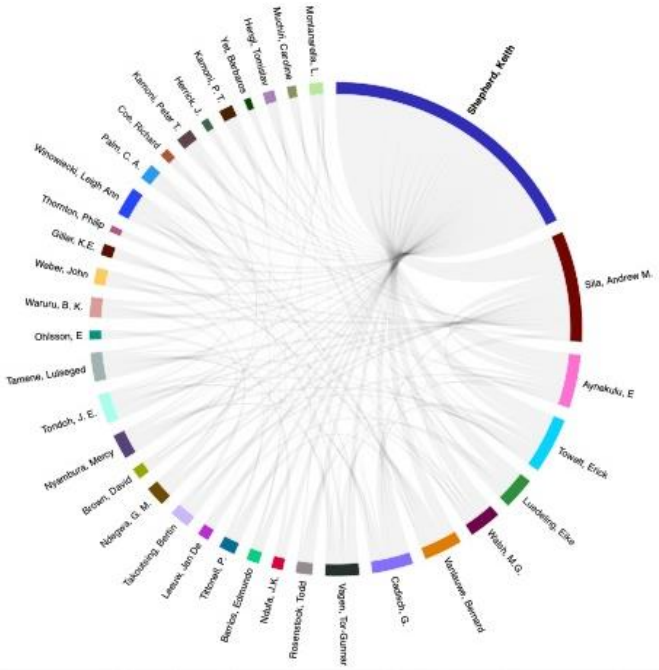
Analysis of the reported outcome/impact, using the evaluation criteria of quality of science and effectiveness (also using findings from document review and/or interviews with key informants).

The research group has established links with a wide range of partners operating at different scales including national service providers and development partners providing support across extended areas. While is unclear whether WLE/ICRAF will be able to continue funding the maintenance and expansion of the research infrastructure, there are efforts to continue funding the soil laboratories by analyzing soil samples on a cost recovery basis.

Cross-referencing to the QoR4D Framework criteria of scientific legitimacy and credibility.

The scientific outputs have been legitimate, as reflected by the large number of partners and co-an average of six authors per academic paper. The co-authors are diverse, and from 6-10 institutions outside CGIAR. The most-cited paper (Hengl et al. 2017) in a medium impact journal (Nutrient Cycling in Agroecosystems, Impact Factor = 2,45) has been cited 40 times but has a surprisingly low Altmetric score of 11. Another relatively young peer reviewed paper in a highly rated journal (Geoderma, Impact Factor 4,84) by Johnson et al. (2019) has been cited three times with an Altmetric score of 5. Guidebooks are normally quite popular, yet the guidebook for Spectral Soil Analysis Household Surveys by Gourlay et al. (2017) has been downloaded a mere 118 times from the CGSPACE site since publication. Most downloads of this handbook over the past 6 months have been by readers from the USA and France. The most logical reason for the relatively low citations and Altmetrics of the papers listed above is that, despite the science being high of quality, soil spectroscopy is a highly specialized field.

Dr. Keith Shepherd, with an H Index of 35 (Scopus) is the driving force behind the OICR and amongst the top 10 publishers of WLE reports and peer reviewed papers in 2019. His team is well recognized as productive CGIAR scientists. Dr. Shepherd's wide co-authorship network, according to the CGIAR Vivo system, is depicted below.



Conclusions

To what extent does the OICR represent the application of the CRPs research to developmental outcomes? What further information would be useful to elaborate that logic, with reference to the CRP theory of change?

The OICRs present two clear trajectories to development outcomes with potential for i) uptake of soil spectral technology with appropriate support and local or national levels and ii) use of high-resolution maps to improve investments by national, development and private sector partners. There are already examples of large-scale use of the update soil maps.

What implicit assumptions are revealed by the OICR analysis? What lessons emerge for the CRP or the CGIAR more generally, based on this outcome?

The ICRAF Soil Lab is not funded on a permanent basis and has been dependent on cost recovery from projects and service provision and—during the period covered by the review—on limited WLE support. Donors are interested in supporting incremental developments but not providing regular support for what is viewed as partner's core infrastructure. This negatively affects innovation and experimentation with novel approaches and applications of the laboratory's outputs. The ongoing service depends on ongoing investment in laboratory infrastructure at the ICRAF level (ICRAF's Soil-Plant Spectral Diagnostics Laboratory) and in national SIS laboratories and on partners' contributions to the soils library, and their willingness to remain WLE's implementation partners. Unlike the financial resources to maintain laboratory infrastructure, partner participation seems to be secure. These soil laboratories provide an International Public Good, however, and are making an important contribution to closing the yield gap in Africa and beyond. If the cost of maintaining and developing the research infrastructure is compared to the total economic benefit to society, then it should be clear that the external benefits to society outweigh the input costs. A comprehensive integrated cost benefit analysis has not yet been done and should be a priority. Longer term sustainability of the service will depend on development of a viable exit strategy and/or business plan to maintain the service, taking the true societal value of International Public Goods into account. While commercial partners are interested there are concerns around i) accessibility of the service and ii) quality assurance if the service becomes fully commercialized. It should also be borne in mind that, once the equipment is in place and maintained, running costs are very low due to the non-consumptive, low impact nature of the methods, which rely on the laws of physics rather than on chemistry. These concerns raise wider questions about i) funding for critical research infrastructure; ii) financing of recurrent service provision, and iii) conditions that need to be in place for centers to let go off innovations and to exit their roles as service providers.

WLE 3362 WLE/ICRISAT integrates smart water management tools and Innovation Platforms in small-scale Zimbabwean irrigation schemes to deliver enhanced water productivity, incomes, and conflict reduction		
CRP Lead: WLE		
Phases of report: New		
If for Innovations at Level 4 or Policies at Levels 2 and 3 No		
Year reported: 2019	Maturity level: 2	# Years of programmatic work: Over 6 years
• Geographic location(s): National - Zimbabwe		
Populations covered, estimated size and socio-demographic categories (e.g., subsistence farmers, women, adolescents, etc.) • The project's first phase covered a total of 452ha2 and served 920 farmers. • The project's funder, the Australian Council for International Agricultural Research (ACIAR), decided to invest in a second phase. Ongoing until 2021, this is bringing the benefits to a further 1700 irrigators, covering 14 new irrigation schemes on 757 ha.		
Key contributors to the outcome		
• CGIAR (other CRPs, Platforms, FPs, centers): • ICRISAT- International Crops Research Institute for the Semi-Arid Tropics		
External partners listed in the OICR: • Australian Center for International Agricultural Research (Bilateral and Donor governments) • Commonwealth Scientific and Industrial Research Organization (Academic) • Australian National University (Academic) • University of South Australia (Academic) • Ministry of Lands, Agriculture & Rural Resettlement (Zimbabwe)(Government)		
Links to the CGIAR Strategic Results Framework: (IDOs and sub-IDOs) • SLO: Agricultural systems diversified and intensified in ways that protect soils and water • IDO: Enhanced benefits from ecosystem goods and services • Sub-IDO: Agricultural systems diversified and intensified in ways that protect soils and water		
WLE contributions to the outcome		
Innovations: None directly reported on the CGIAR Dashboard; however, innovation is at the core of this project		
Policies: None		
Key CRP publications supporting the OICR were published in ISI indexed journals rather than as reports, often as special issues in well rated and appropriate journals. Six further papers were anticipated for publication in 2020 including five papers in a special issue of International Journal of Water Resources Development: 1. Australian Center for International Agricultural Research (ACIAR). 2017. Transforming smallholder irrigation into profitable and self-sustaining systems in southern Africa. https://aciar.gov.au/project/LWR-2016-137. 2. Stirzaker, R., Mbakwe, I., Mziray, N.R., 2017. A soil water and solute learning system for small-scale irrigators in Africa. Int. J. Water Resource. Dev. 33, 788–803. https://doi.org/10.1080/07900627.2017.1320981 3. van Rooyen, A., Ramshaw, P., Moyo, M., Stirzaker, R., Bjornlund, H., 2017. Theory and application of Agricultural Innovation Platforms for improved irrigation scheme management in Southern Africa, International Journal of Water Resources Development. Routledge. https://doi.org/10.1080/07900627.2017.1321530 4. Bjornlund, H., van Rooyen, A., Stirzaker, R., 2017. Profitability and productivity barriers and opportunities in small-scale irrigation schemes. Int. J. Water Resources Dev. 33, 690–704. https://doi.org/10.1080/07900627.2016.1263552 5. Bjornlund, H., Zuo, A., Wheeler, A., Parry, K., Pittock, J., Mdemu, M., and Moyo, M. 2019. The dynamics of the relationship between household decision-making and farm household income in small-scale irrigation schemes in southern Africa. Agricultural Water Management Volume 213: 135-145. https://doi.org/10.1016/j.agwat.2018.10.002 6. Bjornlund, H., K. Parry, J. Pittock, R. Stirzaker, A. van Rooyen, M. Moyo, M. Mdemu, W. de Sousa, E. Cheveia, P. Munguambe, E. Kimaro, Kissoly, L., M. Chilundo, A. Zuo and P. Ramshaw. 2018. Transforming smallholder irrigation into profitable and self-sustaining systems in southern Africa. International Water Resources Association Smart Water Management Case Study Report. Seoul, Korean Water Resources Corporation and International Water Resources Association. Pages 330-385. https://www.iwra.org/wp-content/uploads/2018/11/SWM-report-final-web.pdf		

7. Moyo, M., Maya, M., van Rooyen, A., Dube, T., Parry, K., and Bjornlund, H. 2018. Increasing irrigation water productivity in Mozambique, Tanzania and Zimbabwe through on-farm monitoring, adaptive management and Agricultural Innovation Platforms: End of project survey report Zimbabwe (FSC-2013-006). Canberra, ANU. https://africawaterproject.wordpress.com/updates/publications/
8. Virtual Irrigation Academy description of the tools used. https://via.farm/the-tools/.
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10. Mosello, Beatrice, Naomi Oates, Guy Jobbins. 2017. Pathways for irrigation development: policies and irrigation performance in Zimbabwe. FANRPAN and Pathways to Resilience in Semi-arid Economies (PRISE) Project Working Paper. http://tinyurl.com/ybjfgucpf 17. Increasing irrigation water productivity in Mozambique, Tanzania and Zimbabwe through on farm monitoring adaptive management and agricultural innovation platforms. http://tinyurl.com/yaz5osbwm
11. Moyo M. 2018. New methods in implementing an irrigation scheme bring notable impact. ICRISAT Happenings Newsletter. http://tinyurl.com/ydyfw6r2/
12. Moyo, M. 2018. How smallholder farmers in Zimbabwe are succeeding with irrigation and fighting climate change impacts. http://tinyurl.com/yavtf2pge
13. Pittock, Jamie, Peter Ramshaw, Henning Bjornlund, Emmanuel Kimaro, Makarius Mdemu, Martin Moyo, Sithembile Ndema, Andre van Rooyen, Richard Stirzaker and William de Sousa. 2018. Transforming smallholder irrigation schemes in Africa. A guide to help farmers become more profitable and sustainable. http://tinyurl.com/ya9jqrs9

OICR relationship with CGIAR cross-cutting issues

Capacity development: YES - 1 - significant

- The main focus of the project are farmers and extension workers who participate in innovation platforms.
- The has hosted and supervised one M.Sc. student and one PhD student in Zimbabwe.

Climate change: YES- 1 - significant

- Water savings and greater water productivity are climate smart approaches
- Long term monitoring is essential to track the long-term impacts of climate change on soil moisture.

Gender: YES - 1 – significant

- The project addresses both women and men, with labour savings found to have significant benefits for women.

Youth: NO

Key implementing organization

- ICRISAT

External partners related

- ICRISAT is part of a multi-institutional project team engaged in the Transforming Irrigation in Southern Africa (TISA) project. The Australian Center for International Agricultural – is the core funder. ACIAR channels funds through Australian research institutions, and therefore the project is coordinated by the Australian National University, with ICRISAT as a core member of the team. Australian team members include:
  - Commonwealth Scientific and Industrial Research Organization
  - Australian National University
  - University of South Australia
  - The Ministry of Lands, Agriculture & Rural Resettlement (Zimbabwe) is an implementation partner

Partnerships:

Key partners ([CRP]'s engagement with each partner, and extent to which partner expectations/needs were met or not)

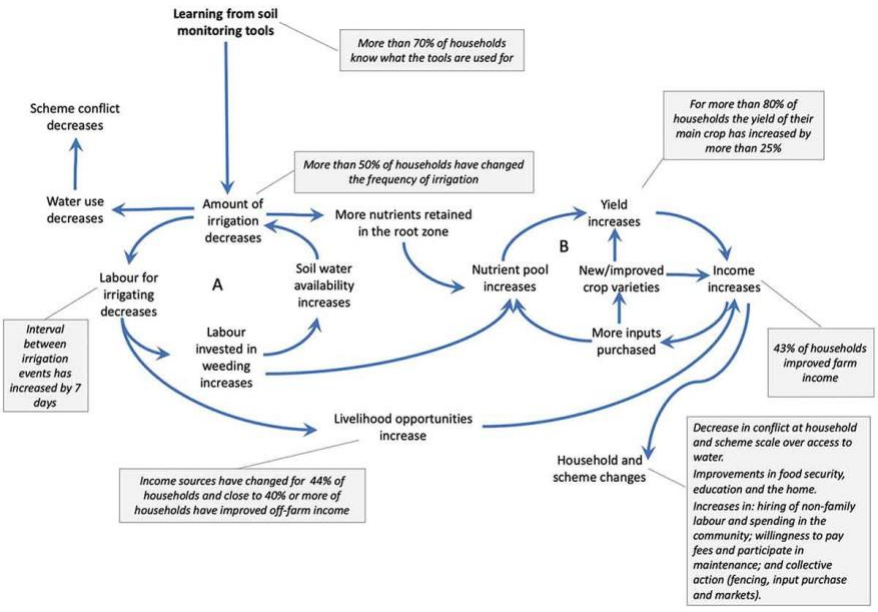
The OICR is an exceptional example of the importance of partnerships, and how these can be leveraged to achieve synergistic outcomes. The research partners have complementary skills and were drawn into the project building the identified disciplinary needs for the research building on an initial contact between The Australian National University and ICRISAT in around 2013. ICRISAT is currently a core member of the research team and contributes to conceptualization and design. The greatest advantages of ICRISAT's involvement are its long-term local presence, the local knowledge of team members, and their access to policy makers and officials in the Ministry of Lands.

The Ministry of Lands (Departments of Irrigation and Extension) are involved in scaling up of the work, that was approved by and developed in conjunction with the Director of Irrigation following demonstration of results at the pilot stage.

- The innovation platform approach engaged beneficiaries and intermediaries such as extension workers as partners in identifying opportunities and constraints to sustaining benefits from technical innovations in small scale innovation platforms. They will serve to engage further actors.
- While there ICRISAT was not directly funded by ACIAR, donor representatives made it clear that the partnership had met their expectations due to a) the equitability of the science partnership; b) the translation of good science into practical solutions and c) the engagement with implementing agencies and policy actors.

Brief reviewer's description of the outcome (based on OICR report, documents cited, original data collected/interviews and other references) *One paragraph summary*

The OICR concerns the scaling up of an approach developed in in two small-scale communal irrigation schemes in Zimbabwe, that combines use of Agricultural Innovation Platforms and smart water management tools (Chameleon soil moisture sensor and the FullStop wetting front detector). The pilots resulted in measurable improvements in water and land productivity, household incomes, and a reduction in conflict levels. The Innovation Platform concept builds on ICRISAT's earlier experiences with goat farmers and is based on the concept of linking production outcomes to market mechanisms and local agricultural knowledge, within the realities of national political economies. The TISA project has achieved transformative change in irrigation by adopting and implementing a complex adaptive systems approach with leverage points (Van Rooyen et al. 2020). The influence diagram depicted below illustrates the complex feedbacks and interactions, resulting in increased yields and decreased water use.



The 'deep' leverage points were a transition from subsistence agriculture to market-based approaches, and changes in the mindsets of all role players. The use of technology, information systems and data played a role, as did the facilitation and understanding of local knowledge and customs. The TISA project demonstrated that dysfunctional irrigation schemes can be transitioned towards complex adaptive systems by offering appropriate technologies, a thorough diagnostic approach, wide stakeholder involvement, and careful selection of strong but achievable interventions.

The Zimbabwe Director of Irrigation agreed to extend the model to 30 more irrigation schemes, covering 757 ha and 1698 farmers, with funding support from the Australian Council for International Agricultural Research (ACIAR) and continued collaboration an established multidisciplinary team of research.

ICRISAT and its partners continue to be actively involved in the scaling up, with an emphasis on monitoring and evaluation including to derive lessons for extension of the approach into new areas. The project is part of a larger programme funded by ACIAR to transform agricultural production systems through innovation platforms and includes study areas in Tanzania and Mozambique. The Zimbabwean component of the study was reported to be the most impactful of the three, in part due to ICRISAT's influence and involvement.

Analysis

Mapping of the outcome to the CRP/Flagship ToC. How does it fit into the narrative of the ToC.
The work contributes to FP2 - Land and Water Solutions for Sustainable Intensification (LWS) CoA 2.2 (Unlocking Value in irrigations systems), with the outcome – 'Improved management of new and revitalized medium to large scale irrigation systems', and two 2021 targets 'Increased water-use efficiency and water productivity by over 5% in targeted ALWM rainfed and irrigation systems in Africa and South Asia on over 5Mha.investments in these regions)' and 'Water delivery services increase water productivity in over 2.5 Mha of irrigation systems'.

The work contributes to the 2019 milestone, 'Consolidate transferring knowledge from tested WLE solutions on farm level tools and management into demonstration in irrigated systems in two countries. The 2019 annual report indicates that the milestone was extended to enable time for national governments in at least three countries to combine on-farm and scheme performance tools to improve irrigation management.
The work reflects two of the principal impact pathways or strategies set out in the FP2 theory of change:

i. Providing demand led research to policy makers at national level with a view to influencing policy (though the later part of this trajectory, policy change, is not explicitly targeted), and
ii. Generating applied solutions through participatory research with national partners (NARES, NGOs, CBOs), and providing vocational training a view to wider uptake of solutions. The assumption for this transition is availability of funding has initially been realized through the agreement of the donor to support a second phase.

Analysis of the reported outcome/impact, using the evaluation criteria of quality of science and effectiveness (also using findings from document review and/or interviews with key informants)
Concerning effectiveness, the initiative represents a small but measurable contribution to the 2021 target, 'Water delivery services increase water productivity in over 2.5 Mha of irrigation systems' at the scale of the project intervention (14 new irrigation schemes on 757 ha).
The potential for longer term effectiveness is very strong in view of i) the engagement of key stakeholders in innovation platforms and deliberate efforts to address constraints and opportunities; ii) support of *the Ministry of Lands and iii) the tangible benefits realized in the pilot project.*

Cross-referencing to the QoR4D Framework criteria of scientific legitimacy and credibility
The work has strong legitimacy and credibility based on engagement of local and national actors form the outset of the project. Many of the peer reviewed papers were published within special issues in the International Journal of Water Resources Development, which has a moderate to high 2019 Impact Factor of 3,14. The latest, and most promising and conceptually advanced paper (Van Rooyen et al. 2020), although still in press, could become a seminal reference on managing transformative change in agro-ecological systems. All the TISA project's publications are good examples of integrated systems approaches to improve food security and livelihoods in semi-arid areas.

With an average of five authors, from different institutions, the publications are highly inclusive and good examples of fair collaborative publication between developed and developing country authors. This is in part due to the equality of the partnership from the beginning, as well as the internal ethics of the partner institutions and funders. This holds lessons for other CGIAR programmes in developing countries about equity in authorship.

The TISA project authors are among the top publishers in WLE. Of the >1400 authors, Björnland (with 7 papers) is 6th, while Moyo and Van Rooyen, with 4 papers each, are amongst the top 20. The paper by Van Rooyen et al. (2017, 22 citations) is #22 on the list of 257 most-cited WLE papers, Moyo et al. (2017, 19 citations) is #27, and Bjornland et al. (2017, 16 citations) is # 33 of 257. One of the TISA project's reports ("Theory and application of Agricultural Innovation Platforms for improved irrigation scheme management in Southern Africa") is the fifth most popular WLE publication in terms of reads

and downloads. With 750 total interactions (612 downloads), it is more popular than any of the peer reviewed articles on the CGSPACE inventory of WLE publications. Altmetric scores of the TISA project are low, possibly because the project is not making optimal use of social media. There are three entries on the WLE Thrive blog site about the TISA project.

Conclusions

To what extent does the OICR represent the application of the CRPs research to developmental outcomes? What further information would be useful to elaborate that logic, with reference to the CRP theory of change?

The research has gone beyond technical innovation to consider how previously dysfunctional small-scale irrigation schemes can be transformed through governance platforms to produce sustainable benefits by adopting market-based approaches, supported by technology and skilled facilitation. It is generating knowledge and know how on solutions amongst users and for potential application in other areas. The research team is exploring further options to extend the value train including based on marketing (research on commodity clusters) to ensure that benefits can be transformed into profit and further investment in local irrigation systems by the beneficiaries. The key issue here is to conceptualize the system as a complex social-ecological system, and to approach innovations through that lens. It is also, however, crucial to be flexible and responsive to local contexts.

What implicit assumptions are revealed by the OICR analysis? What lessons emerge for the CRP or the CGIAR more generally, based on this outcome?

The OICR demonstrates the importance of ownership of solutions by the beneficiaries and of service providers such as the Ministry. Longer term sustainability of the solution will depend on irrigators being able to generate value for increased productivity and agreeing to invest this in maintaining systems, while co-designing solutions.

There is excellent potential to apply the dual approach of technology and innovation platforms in other contexts, with innovation platforms providing a mechanism adaptation of the approach to a local context.

WLE added value to the work by providing an opportunity for exchange with a wider community of researchers working on related issues across the CGIAR network. At a practical level, W1/W2 funding allowed key researchers in ICRISAT to dedicate more time to the project and research outputs that the project funding alone would have permitted.

The initiative has been underway for over six years. The longer-term interest and support of the donor was crucial for allowing the project to mature, with scaling up providing for expansion and consolidation of research and learning. The work has also benefitted from the sustained interest of an extended research team and from stability in the team composition.

WLE 2796 Making the leap from drought monitoring to managing agricultural drought risks in India (WLE-IWMI)		
CRP: WLE		
Phases of report: New		
If for Innovations at Level 4 or Policies at Levels 2 and 3: NO		
Year reported: 2018	Maturity level: 1	# Years of programmatic work: 4+ SADMS was created by WLE with IMWI, CCAFS and the Global Water Partnership in 2014
Geographic location(s): National – India		
Populations covered, estimated size and socio-demographic categories (e.g., subsistence farmers, women, adolescents, etc.) • At the national level, the Ministry of Agriculture prepared more than 620 district agricultural plans with detailed micro-level contingency measures for sustaining agriculture production. • At the district level, the initiative engaged high-level officials, farmer groups and agricultural extension officers in three Indian districts Kurnool in Andhra Pradesh, Amravati and Aurangabad in Maharashtra to implement real-time contingency planning capacity (RTCP) at village level.		
Key contributors to the outcome		
CGIAR (other CRPs, Platforms, FPs, centers): • IWMI (Lead Center) • WLE FP4 - Managing Resource Variability, Risks & competing uses (climate, flood/droughts, water-energy-food nexus, groundwater, watersheds, wetlands) • CCAFS - Climate Change, Agriculture and Food Security (CRO)		
External partners listed in the OICR • MoA - Ministry of Agriculture (India) - *Government* • ICAR - Indian Council of Agricultural Research - *Academic* • USAID - U.S. Agency for International Development - *Bilateral and Donor governments*		

Links to the CGIAR Strategic Results Framework: (IDOs and sub-IDOs)
• SLO: Improve Natural resources and ecosystem services
• IDO: More sustainably managed agroecosystems
• Sub-IDOs:
  • Enhanced adaptive capacity to climate risks (More sustainably managed agro-ecosystems)
  • Enhanced adaptive capacity to climate risks and extremes (Mitigation and adaptation achieved) (Climate CCI)
The initiative was also identified as contributing to the SRF 2022/2030 target: # of people, of which 50% are women, assisted to exit poverty, related to the SLO, Reduce Poverty.		

WLE contributions to the outcome		
Innovations: • No 2017–2019 innovations associated with this OICR		
Policies: • Policy 233 (2018: Level 1) Supported by WLE and CCAFS, the South Asia Drought Monitoring System is being used by the Indian government to make cropping recommendations to farmers, target drought relief efforts and develop district contingency plans.		
Key CRP publications supporting the OICR 1. Amarnath G.; Clarke J. 2016. Drought monitoring system helps strengthen resiliency to climate change. World Water 39(1): Jan/Feb Issues 14-15. https://cgspace.cgiar.org/handle/10568/78189. 2. Amarnath, G.; Alahacoon, N.; Pani, P.; Chockalingam, J.; Mondal, S.; Matheswaran, K.; Sikka, A.; Rao, K.V.; Smakhtin, V. 2019. Development of South Asia Drought Monitoring System. In Drought challenges: Livelihood implications in developing countries. Elsevier Publisher. 35 pages (April 2019). 3. Amarnath, G.; Rao, K.V.; Alahacoon, N. 2019. Integrating satellite drought monitoring and information to support real-time implementation of agricultural contingency plans to mitigate drought risks in Southern India. Water Resource Management Journal. In Review 4. Amarnath G.; Alahacoon N.; Bhatpuria D. 2019. Monitoring spatio-temporal pattern of drought stress using integrated drought severity index over South Asia region, India. Natural Hazards Journal. In Review 5. Matheswaran K., Alahacoon N., Pandey R., and Amarnath G. 2019. Flood risk assessment in South Asia to prioritize flood index insurance applications in Bihar, India, Geomatics, Natural Hazards and Risk, 10:1, 26-48, DOI:10.1080/19475705.2018.1500495		

Others
IWMI SDAMS Drought Bulletin: http://www.iwmi.cgiar.org/resources/drought-monitoring-system/drought-bulletin/
Three District Contingency plans (Links provided)
IMWI Award https://www.geospatialworld.net/blogs/iwmis-space-based-drought-system-wins-award/

OICR relationship with CGIAR cross-cutting issues (YES/NO)

Capacity development: YES – 2- principal

Climate change: YES – 2 – principal

Gender: NO

Youth: NO

Key implementing organization (e.g. institute, partner)

- IWMI (Lead Center)

External partners related

- MoA - Ministry of Agriculture (India) - Government
- ICAR - Indian Council of Agricultural Research - Academic

Partnerships: Key partners ([CRP]'s engagement with each partner, and extent to which partner expectations/needs were met or not)

- The main partner in the development and testing of RTCM was the Indian Council of Agricultural Research (ICAR), that works in a regular with IWMI in the basis of an MOU. The work was codeveloped based on a proposal prepared by WLE/IMWI under the umbrella of the MOU. The work added value within the context of ICAR's ongoing work in contingency planning and DRR.
- A key partner at local level was the Ministry of Agriculture extension system
- USAID is mentioned as a donor in the OICR. Other donors include the Japanese Ministry of Agriculture, Forestry and Fisheries.
- SADMS was originally developed in a partnership with the Global Water Partnership (GWP) whose South Asia Office continues to be hosted by IMWI.

Brief reviewer's description of the outcome

The South Asia Drought Monitoring System (SADMS) was created by the CGIAR Research Program on Water, Land and Ecosystems (WLE) and partners in 2014 integrates a range of remote sensing data monitoring and forecasting component of SADMS is based on indices (including vegetation health, rainfall levels and soil moisture) to provide real-time drought severity data at high resolution to different users. SADMS is identified as a WLE and CCAFS (Phase I) product.

The system was applied to drought affected states in 2017-2018 to generate maps and periodic drought bulletin, targeting authorities and decision makers, and was used to inform drought relief efforts.

The OICR concerns an effort by the Indian Council of Agricultural Research (ICAR) and WLE/IWMI to provide real-time information to support implementation of agricultural contingency plans in three districts in two southern States. Real-time contingency planning capacity (RTCP) measures were implemented at the village level including drought tolerant seed varieties, supplementary irrigation, rainwater harvesting, and spraying of Potassium Nitrate to enhance drought stress. The crop yields and incomes in these areas were significantly higher than in the control areas. The concept and framework are being scaled up by the Karnataka State Natural Disaster Monitoring Centre.

The World Bank and other donors have adopted the approach for use in other countries, including the Next Generation Drought Index Project that is exploring how financial responses can be triggered in the event that particular drought conditions arise Senegal and Mozambique. The partnership in India is ongoing and WLE /IWMI and ICAR recently agreed to establish a 'One India Drought Monitoring' program building on the experience.

Analysis

Mapping of the outcome to the CRP/Flagship ToC. How does it fit into the narrative of the ToC?
The initiative is associated with FP 4 Outcome 4.1: Uptake of solutions to enhance resilience to extreme water variability at different levels, associated with the Climate Change (CCI) Sub IDO; Enhanced adaptive capacity to climate risks and extremes (Mitigation and adaption achieved)

It is expected to contribute to two FP4 2021 Targets:

- Investments to reduce hydrological variability impacts by 5% adopted in selected irrigation systems in South and Southeast Asia; Investment, policy and institutional changes contribute to up to USD 20 million in avoided damages each year by 2022 in the Ganges Basin alone.

- Landscape-based variability management approaches adopted by a minimum of 6 million households in India and Bangladesh, poverty alleviation for up to 3 million people in the same countries: additional but smaller outcomes in sub-Saharan Africa.

The work is reflected in FP4 milestones including '*Regional flood and drought forecast and early warning tool developed …'* (2018), '*Innovative approaches for mitigating flood and drought risk …* '(2019), and '*WLE diagnostic and planning tools developed for flood and drought mitigation …'* (2019). 2019 and 2020 milestones reflect the expansion of the approach into other countries on South and Southeast Asia.

The 2021 milestone at outcome level "Adoption by governments, multilateral agencies, NGOs, and the private sector of innovative WLE solutions that enhance climate risk management at multiple scales across South and Southeast Asia, including i) real-time flood and drought advisory services; ii) bundled weather insurance; and iii) managed aquifer recharge" brings different strands of work under Outcome 4.1 together with an emphasis on uptake by a range of institutional, funding and practitioner organizations.

Analysis of the reported outcome/impact, using the evaluation criteria of quality of science and effectiveness (also using findings from document review and/or interviews with key informants).
SADMS was used to inform development of contingency plans and guide the implementation of real time support measures at the local level. The results at local level showed improvement in yields and livelihoods comparted to other areas.
The potential for impact at scale depends on wide-spread use of the data services dissemination of timely information to guide support measures at level levels. WLE /IWMI and ICAR recently agreed to establish a 'One India Drought Monitoring' program building on the experience.
IWMI was awarded the Geospatial World Excellence Award 2020 in recognition of this work.

Cross-referencing to the QoR4D Framework criteria of scientific legitimacy and credibility

SADMS is an established and award-winning service.

Co-design with ICAR, and well-established NARES and also funding agency, had contributed to ensuring relevance and credibility. The work is solutions oriented, applies cutting edge technology to provide real time information to users, and is widely applicable and transferable. National and local government authorities as the next user fully engaged. The results and process are institutionalized through government plans.

Most of the publications cited as evidence are in review and could not be accessed. Pilot projects in India and Bangladesh demonstrate that index-based weather insurance products, developed using satellite technology, can reduce the financial risks to smallholder farmers from floods and droughts. Scaling up such schemes has the potential to meet the needs of very vulnerable groups, especially women and assist governments in meeting global development goals. The book chapter "Development of a system for drought monitoring and assessment in South Asia" sheds light on the relevance and legitimacy of the evidence. The publication (Amaranth et al. 2019), is co-authored with 8 other scientists, all except one of them from Asia. It reports on a novel Integrated Severity Index that reflects the effects of drought as observed through both satellite-derived vegetation data and the level of dryness expressed by traditional climate-based drought indices. It uses temperature, rainfall, vegetation, and soil quality data in an integrated manner, which exemplifies WLE's systems approach. While the publication lacks a socio-economic component, it uses a highly integrated methodology supported by multiple remotely sensed data sources to develop an integrated drought severity index. The paper concludes that their approach may "foster the development of an enabling environment for smallholder farmers to adopt climate-smart production practices and develop climate-resilient livelihoods, all while protecting them from damaging climatic extremes". The paper was tweeted six times and read another six on Mendeley. Matheswaran et al. (2019) then expanded this methodology to identify potential zones for piloting flood index insurance scheme in Bihar, India. Bihar was further assessed for sub-regional segmentation of its 37 districts into four flood risk zones-based cluster analysis of multi-modal dataset consisting of demographics, meteorological, agricultural, flood characteristics and economic loss from floods. Satellite based risk assessment identified parts of Indus basin in Pakistan, Ganges basin in North India and majority of Bangladesh as flood hotspots. Site prioritization for flood index insurance in Bihar identified Madhubani, Darbhanga, Muzaffarpur and Sitamarhi districts as very high flood risk districts by both methods signifying large impact of any

potential interventions implemented in these districts. This modelling has the potential to mitigate at least USD 20 million per year economic losses suffered by smallholder farmer communities.

Conclusions

To what extent does the OICR represent the application of the CRPs research to developmental outcomes?

The OICR presents a proven example of how WLE research can be used to develop, maintain and improve a data service with far reaching potential to inform contingency planning and real time support measures. The value of the service lies in its being accessible to and used by relevant bodies including authorities, development agencies and non-government organizations. There is already clear evidence of the wider uptake and transferability of the approach.

The WLE/IMWI researcher is actively pursuing links with relevant partners including the international disaster risk reduction (DRR) community and had raised awareness of the facility through participation in conferences and events. Further development of the technology and outreach could be usefully complemented by long term monitoring of the conditions required to support application at the local level. This is beyond WLE's reach but may be pursued through partners such as ICAR.

What implicit assumptions are revealed by the OICR analysis? What lessons emerge for the CRP or the CGIAR more generally, based on this outcome?

Scaling of Innovations and Services: The success of this work depends at present on the continued hosting and maintenance of the system by IWMI. The research team is actively exploring how to i) reduce associated costs and ii) enable roll out of the system and services beyond a level that IMWI could realistically sustain. The group has received support from technology partners. It is exploring a range of measures to expand reach and ensure accessibility including use of cloud services, is providing direct access to the system by partners, and is exploring how it may be able to develop remote updates of software held by partners.

Implementation Partners: The success and of this work and durability of results depends on its uptake of services/facilities by partners operating at the local level to extension service structure to share timely information, provide decision support to farmers (e.g., when and what to plant to replant) and where appropriate provide support measures.

Timing: Six years passed between SDAMS being developed and its value and potential being recognized in the 2020 Geospatial World Excellence Award.

Annex 9: Analysis of the WLE Theory of Change

WLE Results Framework

The WLE project document includes results frameworks and theories of change (ToCs) for the WLE as a whole and and for each of the flagships. The ToCs are essentially an expanded narrative account of their results frameworks (comprising outcomes, 2022 targets, and SLO or CCI sub-IDO alignment) enriched by an explanation of strategies, assumptions, and illustrated using a set of impact pathways.

The WLE results frameworks includes quantified contributions to the SLOs, that are now described as aspirational (in the same way as the CGIAR SLOs). The FP results frameworks or ToCs described alignment and, at least implicitly, that there is an expected contribution thematic and CCI sub-IDOs but the contribution is not specified or, in most cases, quantified

The FP outcomes are broad statements of intent that is some cases resemble strategies more than outcomes. As such they provide a sense of direction for planning and delivery under each cluster of activity. The outcomes provide a limited basis for measuring effectiveness.

These were specified through 2022 (later 2021) targets at outcome and impact level that are specific, and timebound, and ambitious rather than realistic. They may prove difficult to measure where they are not the result of a direct intervention by one of the WLE associated centers and its partners. They are now viewed as aspirational.

The FP hierarchy is completed at activity and output level by milestones that were set out in a project document annex. The original intervals were not always annual and successive milestones represented an incremental progression towards the outcome targets.

The WLE results framework has been repeatedly amended, while retaining the overall structure set out in the programme document. Amendments to outcomes are summarized and justified in the annual reports.

- Two objectives were merged in 2018 was to streamline the FP/CoA structure and one outcome was dropped when expected funding failed to materialize.
- The wording of WLE outcomes was more systematically amended in 2019. There are incorporated into the 2020 PoWB. The revised outcomes are clearer and reflect the original focus of the FPs, but in some cases are less specific and less ambitious.
- Milestones have been further developed in the annual programs of work and budgets (POWBs). There are only a few cases where milestones lead to the target (or contribute directly to the measurable result described in the target. The WLE sub-IDO targets introduced in 2019 describe more immediate outcomes and are achievable.

Table 14 provides an overview of the WLE results framework as of April 2020. The 2022 (now 2021) targets are outcome or impact level and considered aspirational. These are largely unchanged with the exception FP1 where targets have been reformulated as immediate outcome with a level of ambition that could be realistically achieved and measured by 2021. WLE sub IDO indicators at a more achievable level were introduced to the 2019 Annual report but have not been used in reporting.

Table 14: Overview of WLE Results Framework (WLE Version of April 2020)

Flagship	Cluster of Activity (CoA)	Outcome (2020)	2021 Targets (2020)	Match to Sub IDO (2020)
Flagship 1 - Restoring Degraded Landscapes (RDL)	CoA 1: Landscape Restoration	Outcome 1.1: Better informed landscape restoration policies, approaches and interventions.	**2021 Target:** 10 landscape restoration policies, approaches, interventions in up to 8 countries informed by best practice on soil, water and biodiversity management (e.g. Ethiopia, Kenya, Uganda, Tanzania, Uzbekistan, Colombia and Peru, El Salvador).	**SLO - NATURAL RESOURCES** Increased resilience of agro-ecosystems and communities, especially those including smallholders
	CoA 1.2: Soil Restoration and Soil Carbon	Outcome 1.2: Policies, strategies and interventions investing in practices that rehabilitate or protect soil fertility and soil carbon.	**2021 Target:** 10 strategies and programs investing in research informed best-bet practices that rehabilitate or protect soil fertility and soil carbon in up to five countries by 2021 (Kenya, Ethiopia, Tanzania, Colombia and El Salvador).	**CCI - CLIMATE CHANGE** Reduced net greenhouse gas emissions from agriculture, forests and other forms of land-use
	CoA 1.3: Restoration Assessment and Monitoring	Outcome 1.3: Strengthen approaches to the monitoring and evaluation of land restoration and the assessment of land degradation risks.	**2021 Target:** At least two tools in five countries being taken up and applied by 2021.	**CCI - POLICIES AND INSTITUTIONS** Increased capacity of partner organizations, as evidenced by rate of investments in agricultural research
Flagship 2 - Land and Water Solutions for Sustainable Intensification (LWS)	CoA 2.1: ALWM Solutions for Resilient Smallholder Livelihood and Landscape Systems	Outcome 2.1: Policy and practice informed by more effective agricultural land and water management solutions and investment options	**2021 Target**: Adoption of ALWM solutions benefit 2 million HH in WLE and AFS-CRP landscapes (30% female). **2021 Target:** Improved irrigation systems management benefits over 1 million farm households (30% female).	**SLO - REDUCED POVERTY** Reduced smallholders production risk
	CoA 2.2: Unlocking Value in Irrigation Systems	Outcome 2.2: Improved management of new and revitalised medium to large scale irrigation schemes	**2021 Target**: Increased water-use efficiency and water productivity by over 5% in targeted ALWM rainfed and irrigation systems in Africa and South Asia on over 5Mha.investments in these regions). **2021 Target**: Water delivery services increase water productivity in over 2.5 Mha of irrigation systems.	**SLO - NATURAL RESOURCES** Agricultural systems diversified and intensified in ways that protect soils and water
Flagship 3 - Sustaining Rural-Urban Linkages (RUL)	CoA 3.1: City-Region Food Systems and Urban Food Security	Outcome 3.1: Increased capacity and evidence for male and female stakeholders and policy makers to implement urban and peri-urban agriculture (UPA) related policies and farming system innovations	**2021 Target:** Sustainable intensification with increased water- and nutrient-use efficiency supported on 4Mha of urban and peri-urban irrigated and rainfed croplands.	**CCI - POLICIES AND INSTITUTIONS** Conducive agricultural policy environment
	CoA 3.2: Business Options for Nutrient, Water and Energy Recovery and Reuse	Outcome 3.2: Increased business capacities in nutrient, water and energy recovery from domestic and agro-industrial waste for intensified food crop production	**2021 Target**: Investment strategies of five major international financial institutions (IFIs) and other donors refer to WLE. National guidelines change in over 9 million rural households' management practices. **2021 Target:** Nutrient- and water-use efficiency increased on 3.6 Mha through resource recovery from food waste, returning via RRR of 10% initial nitrogen (N), phosphorus (P), and potassium (K) applications. In addition, 2 million tonnes carbon dioxide equivalent (tCO2e) per year will be avoided through changes from landfilling to composting. **2021 Target**: 15 cities adopt IUWM to harmonize rural and urban water demands 0.5 million of wastewater-using farm households understand safer irrigation practices	**CCI - CAPACITY DEVELOPMENT** Increased capacity for innovation with partner development organizations and in poor and vulnerable communities
Flagship 4 - Managing Resource Variability, Risks and Competing Uses for Increased Resilience (VCR)	CoA 4.1: Managing Resource Variability and Risks for Resilience	Outcome 4.1: Risks associated with water variability mitigated	**2021 Target:** Investments to reduce hydrological variability impacts by 5% adopted in selected irrigation systems in South and Southeast Asia; Investment, policy and institutional changes contribute to up to USD 20 million in avoided damages each year by 2022 in the Ganges Basin alone. **2021 Target:** Landscape-based variability management approaches adopted by a minimum of 6 million households in India and Bangladesh, poverty alleviation for up to 3 million people in the same countries; additional but smaller outcomes in sub-Saharan Africa.	**CCI - CLIMATE CHANGE** Enhanced capacity to deal with climatic risks and extremes
	CoA 4.2: Managing Competing Uses and Trade-offs	Outcome 4.2: Uptake of solutions and investment options better able to address tradeoffs across competing water-energy-food needs	**2021 Target**: 10% of water-energy-food nexus savings valued at USD 2 billion targeted in Ganges, Nile, Volta and Mekong river basins (leveraging billions of USD in planned infrastructure investments in these regions). **2021 Target**: Agricultural water pollution levels (nitrogen [N], phosphorus [P], sediments and salinity) reduced by 5% over baseline increase in Asian breadbasket region	**SLO - NATURAL RESOURCES** More productive and equitable management of natural resources
Flagship 5 - Enhancing Sustainability across Agricultural Systems (ESA)	CoA 5.1: Assessing decision-support approaches for sustainable agricultural landscapes	Outcome 5.1: Decision makers are better able to access relevant evidence, tools and expertise to design and manage natural resource management (NRM) and agriculture programs that deliver more effectively against multiple SDG targets	**2021 Target:** 6 million hectares of degraded land restored	**CCI - CAPACITY DEVELOPMENT** Increased capacity of innovation in partner development organizations and in poor vulnerable and communities
	CoA 5.2: Testing and refining approaches and tools to effectively deliver sustainability of landscapes at scale	Outcome 5.2: NRM and agricultural development programs that apply WLE approaches and use tools are more cost-effective and avoid negative trade-offs between SDGs across scales.	**2021 Target:** 21 million farm households with improved practices	**SLO - NATURAL RESOURCES** Increased resilience of agro-ecosystems and communities, especially those including smallholders

Match to CGIAR System Results Framework (SRF)

The revised WLE SRF includes comprehensive changes in the identification of the sub-IDO to which WLE CoAs contribute, with CoAs now identified as contributing to one SLO or CCI sub-IDO instead of multiple IDOs in the original FP results frameworks (Figures 16 & 17).

Figure 16: WLE contribution to System Level Outcomes (SLOs)

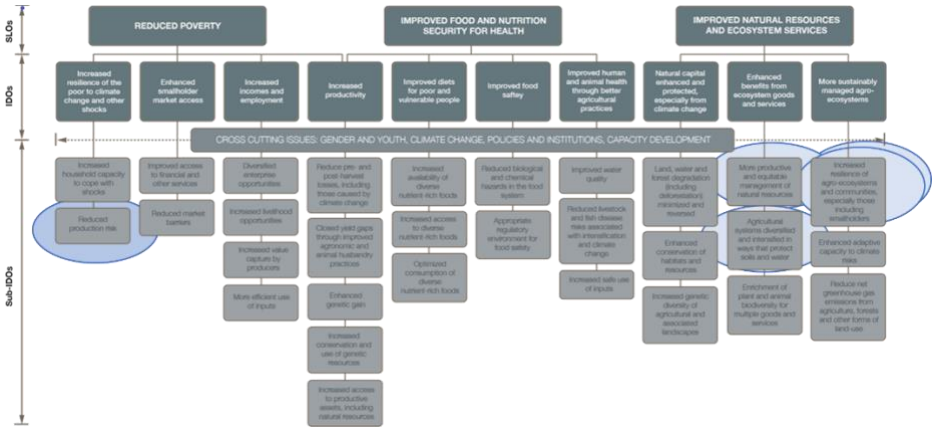
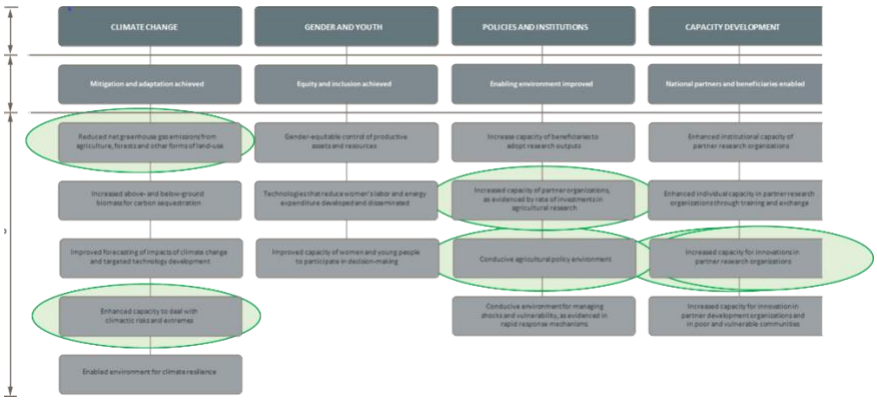


Figure 17: WLE contribution to Cross Cutting Issues (CCIs)



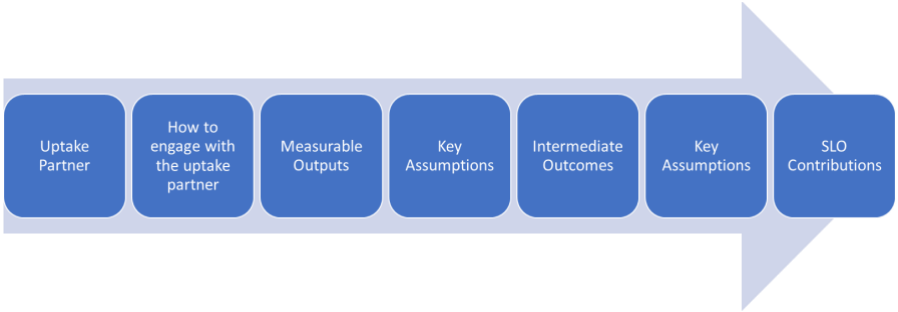
Impact pathways

The 2020 alignment of WLE outcomes with cross cutting IDOs (rather than impact related sub-IDOs), notably 'capacity development' and 'policies and institutions', appears to mark a shift in strategic thinking towards capacitating and enabling change processes rather than delivering impacts.

The WLE and FP ToC narratives are accompanied by a graphic showing several parallel impact pathways to which the WLE as a whole or the FPs contribute. The graphics follows structure (Figure 18) with the first stages describing: 'uptake partner', 'how to engage with the uptake partner', and 'measurable outputs[5], which fall within the *sphere of control* of the program. There are minor differences on this theme. The WLE program level ToC includes an additional stage of inputs; namely the five flagship programs, and a cross cutting gender and inclusive development component. The FP2 (LWS) ToC shows two strategic approaches (identified under two clusters of activity) as inputs.

5 The underlined terms are those that would typically appear in a theory of change figure and correspond to steps in an impact pathway. Assumptions (and /or) drivers and stakeholders are often positioned outside the pathways of a ToC. ToCs typically include more than one stage of intermediate outcome, an approach that corresponds to the multiple maturity levels of CGIARs MARLO-reported innovations and policies.

Figure 18: Schematic of WLE impact pathways used in WLE & FP ToCs



The second part of the graphics sets out 'key assumptions' for moving from outputs to intermediate outcomes, the 'intermediate outcomes' themselves, 'key assumption's for moving from intermediate outcomes to SLO contributions, and the 'SLO contributions' themselves which can be considered as impacts. Intermediate outcomes and impacts fall within the spheres of influence and interest of the program. There is little specification of outputs and intermediate outcomes with the result that the impact pathways are generic in nature, as may be expected at a program level

The impact pathway graphics reflect that there are feedback loops between the different stages and engagement with partners is identified as a continuous two directional dialogue. The WLE narrative description of the ToCs acknowledges that the graphic representations are an oversimplification of a complex situation.

The starting point for each of the impact pathways is the intended uptake partner, with seven groups of partners identified across the six ToCs. The emphasis on uptake partners is a useful entry point for future effectiveness, bridging from science to influence of policy, practice and investment. The approach reflects a lesson from Phase I, where the final report (AR 2016) noted "The major assumptions underpinning effective delivery have involved the willingness of key change agents – i.e., policy-makers and investors – to utilize the new approaches supported by research. Most of WLE's achievements result from a long-term engagement with multiple partners along the impact pathway, including immediate clients, and in-depth research that involves thinking laterally across sectors and/or disciplines."

The WLE FP impact pathways[6] reflect the WLE mechanisms for influencing change: evidence, solutions (as outputs), changed perspectives, and action (intermediate outcomes). The intermediate outcomes show differing levels of maturity for different groups[7]. 'How to engage' lists a range of suitable approaches and implicit strategies for engagement of the uptake partner; outputs are essentially services provided to the stakeholders concerned; and intermediate outcomes reflect changes in behavior or at least awareness in the uptake partner.

While the narrative account of the ToCs differ for each programme, the overall strategy of influencing decision making and action through provision of scientific evidence (of the need for change and /or of solutions to identified issues) is similar for each. This approach is echoed, albeit with additional steps, in the CGIAR systems of maturity levels for MARLO-reported OICRs, innovations and policies whose narrative descriptions also place emphasis on the target audience or update partner.

The WLE ToCs do not refer explicitly to drivers. The Review found that there is scope to change some of the assumption related to uptake into drivers by addressing these at the design stage of the initiative to ensure relevance and credibility, in line with the CGIAR QoR4D approach.

[6] The ToC and related impact pathway graphic for FP5 (ESA) was revised as part of the overall revision of the flagship in 2017.The impact pathways differs in structure to the other FPs, showing the FP's strategic approaches as inputs (like FP2) and placing 'outputs' before 'uptake partners'. The different stages of the impact pathways and related strategies for the revised FP5 ToC are specified in greater detail than those of the earlier ToCs. The impact level includes quantified contributions to three GCIAR SLOs.

[7] For example, 'awareness of need for change' for global dialogue stakeholders, is at a lower level than 'investments supporting change' for investors.

Annex 10: Conflict of Interest Statements by the Review Team

Annex 1 - Conflict of Interest Statement – CGIAR Advisory Services

1. Main employer and any other organization that provides you with remuneration (which may be named participants in the project/program/proposal you are being asked to review/evaluate)

   Please provide details: Self employed /NA

2. Are you aware whether a relative, close friend, close colleague or someone with whom you have financial ties is receiving funding from or giving advice to a project/program/proposal you are being asked to review/evaluate?

   ~~Yes/~~No

   If Yes, please provide brief details:

3. Does any project/program/proposal you are being asked to review/evaluate cite any of your own current research?

   ~~Yes/~~No

   If Yes, please provide brief details:

4. Does any project/program/proposal you are being asked to review/evaluate name researchers with whom you have active collaborations, recently published joint papers or are in regular email correspondence?

   ~~Yes/~~No

   If Yes, please provide brief details:

5. Does any project/program/proposal you are being asked to review/evaluate name any of your past PhD students are active participants?

   ~~Yes/~~No

   If Yes, please provide brief details:

Declaration: I declare that the information provided on this statement is true and complete.

Name: Sarah Humphrey

Signed:

SHumphrey

Date: 24 August 2020

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Annex 1 - Conflict of Interest Statement

1. Main employer and any other organization that provides you with remuneration (which may be named participants in the project/program/proposal you are being asked to review/evaluate)

   Not applicable

2. Are you aware whether a relative, close friend, close colleague or someone with whom you have financial ties is receiving funding from or giving advice to a project/program/proposal you are being asked to review/evaluate?

   No

3. Does any project/program/proposal you are being asked to review/evaluate cite any of your own current research?

   No

4. Does any project/program/proposal you are being asked to review/evaluate name researchers with whom you have active collaborations, recently published joint papers or are in regular email correspondence?

   Yes

   I recently published a paper[7] with Dr Sonja Vermeulen was one of the authors. We did not, however, directly collaborate or interact.

5. Does any project/program/proposal you are being asked to review/evaluate name any of your past PhD students are active participants?

   No

Declaration: I declare that the information provided on this statement is true and complete.

Name: Christo Fabricius

Signed:

Date: 23 August 2020

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7 Anderson, C. M., C. L. Weber, C. Fabricius, L. Glew, J. J. Opperman, P. Pacheco, L. H. Pendleton, D. Thau, S. J. Vermeulen, and M. R. Shaw. 2019. Planning for Change: Conservation-Related Impacts of Climate Overshoot. BioScience 70:115–118.

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