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MARCH 2024

FINAL REPORT

Impact Evaluation Feasibility Assessment for the USAID/Southern Africa Ecosystems, Communities and Climate, Cubango-Okavango Activity

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INRM ECCO Feasibility Assessment

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Acronyms

ACADIR	Associação de Conservação do Ambiente e Desenvolvimento Integrado Rural
ADPP	Ajuda de Desenvolvimento de Povo para Povo
ARISE	The Agency, Resources, and Institutional Structures of Sanitation-related Empowerment
DiD	Difference-in-Differences
DW	Development Workshop
eCAS	Electronic Catch Assessment Survey
ECCO	Ecosystems, Communities and Climate, Cubango-Okavango
FA	Feasibility Assessment
GESI	Gender Equality and Social Inclusion
HWISE	The Household Water InSecurity Experiences Scale
INRM	Integrated Natural Resource Management
IP	Implementation Partner
MDES	Minimum Detectable Effect Sizes
MERL	Monitoring, Evaluation, Reporting, and Learning
PE	Performance Evaluation
RCT	Randomized control trial
SA	Strategic Approach
SWPER	Survey-based Women's Empowerment Index
TNC	The Nature Conservancy
ToC	Theory of Change
WASH	Water, Sanitation, and Hygiene
WTP	Willingness-to-Pay
USAID	United States Agency for International Development

Executive Summary

Objective

The objective of this feasibility assessment (FA) is to assess the possible evaluation options for the Ecosystems, Communities and Climate, Cubango-Okavango (ECCO) activity in Angola. The assessment considers design options that draw upon recent evidence and techniques that meet Agency-wide, HEARTH, and ECCO-specific learning objectives related to cross-sectoral benefits, attitude and behavior change, threat reduction, and biophysical impacts with the goal of determining the most rigorous options that can be applied given implementation, resources, and other constraints.

Strategic Approaches

The ECCO activity will be implemented in the Cubango-Okavango region of Angola by a consortium of public and private sector partners led by The Nature Conservancy (TNC). ECCO aims to sustainably improve livelihoods and human well-being through program interventions that also improve the landscape's vital natural resources.

ECCO does this through three strategic approaches (SA):

SA1: Conservation livelihoods for biodiversity, forests, and climate resilience
SA2: Water, sanitation, and hygiene (WASH); and water resource management
SA3: Cross-sector landscape collaboration for biodiversity and human well-being

In addition to these strategic approaches, ECCO integrates Gender Equality and Social Inclusion (GESI) and inclusion of youth into each strategic approach and the activity as a whole.

Evaluation Approaches

The FA team considered a wide range of evaluation approaches, focusing on impact evaluations that measure causal impacts of programming. Given the nature of the project being evaluated, quasi-experimental approaches were most applicable. The quasi-experimental approaches measured causal impacts without randomization (rather, identification of a comparable control group), while maintaining rigor and confidence.

Summary of Findings

The FA team found a myriad of opportunities to evaluate ECCO's activities using a rigorous approach that can greatly contribute to understanding of conservation-based livelihoods and WASH. SA1 provides the opportunity to improve understanding around 1) sustainable inland fishing practices and 2) conservation agriculture. For both and fisheries in particular, evaluations are rare, gender impacts are largely unknown, and measures of linkages between conservation and livelihood outcomes are scarce – with no papers found on these topics. Evaluations of overlaps of these activities also allow for examination of additional avenues of diet diversification. Evaluation options include a matching and

difference-in-differences design (DiD), which would require multiple rounds of baseline data collection and the early matching of villages.

The FA team also found substantial learning opportunities around SA2, which examine the impacts of WASH interventions. WASH interventions have often been poorly studied due to examining interventions with insufficient coverage, not having a comprehensive list of outcomes, and not directly measuring enteric infection or water quality and using proxies not fit for purpose.[1] [2] The FA team proposes an evaluation of SA2 using matching and DiD to evaluate large-coverage WASH interventions by measuring various outcomes including knowledge, practice, time savings, willingness to pay, enteric infection (measured through stool sampling), and water quality (measured through water testing). For SA3, the FA team proposes a process evaluation and case study analysis of private sector involvement and the success of information sharing across implementing partners (IPs).

For the proposed evaluations, the FA team will consider ECCO's cross-cutting themes of gender and social inclusion, and inclusion of youth. Evaluations will include key outcomes—which are known to specifically impact marginalized groups—such as time-savings, differences in practice and participation of women and youth, and empowerment and voice. The integration of these cross-cutting themes into the evaluations will provide learning outcomes to aid ECCO and other similar activities in better involving women and youth; as well as provide novel and urgently needed knowledge to the broader natural resource management and water resource management communities.

RECOMMENDATIONS

In addition to the key findings above, the FA team recommends the following actions to United States Agency for International Development (USAID):

- Establishing strong counterfactuals by determining intervention areas early on, and matching them to control areas;
- Holding pause and reflect sessions to refine the Theory of Change (ToC) in line with evaluation and routine Monitoring, Evaluation, and Learning findings;
- Measuring a holistic suite of outcomes based on activity ToCs and logic models, and utilizing direct measures of outcomes rather than proxies;
- Evaluating long term effects of programming and sustainability after ECCO ends through separate long-term, locally based monitoring; and
- Strong local coordination and collaboration throughout design, implementation, and dissemination of the evaluation.

[1] Rego, Ryan T. et al., "A Comparison of Traditional Diarrhea Measurement Methods with Microbiological And Biochemical Indicators: A Cross-Sectional Observational Study in the Cox's Bazar Displaced Persons Camp" EClinicalMedicine (2022). https://doi.org/10.1016/j.eclinm.2021.101205

[2] Watson, Samuel I., Rego, Ryan T., Hofer, Timothy, Lilford, Richard J., "Evaluations of Water, Sanitation, and Hygiene Interventions Should Not Use Diarrhoea As A (Primary) Outcome." BMC Global Health (2022). https://doi.org/10.1136/bmjgh-2022-008521

Introduction

Overview

The objective of the FA is to assess possible options for a rigorous evaluation of the effectiveness of the ECCO activity in Angola. The five-year ECCO project, beginning in 2022, is implemented by TNC and their partners. ECCO aims to sustainably improve livelihoods and human well-being through interventions that also improve the landscape's vital natural resources. This FA, conducted under the Integrated Natural Resource Management (INRM) Task Order, includes identifying illustrative impact evaluation and performance evaluation design options that meet Agency-wide and HEARTH-specific learning objectives. This report will provide an assessment of ECCO's current theory of change (ToC), evaluation design options, methods, challenges and limitations, logistic considerations, and next steps – proposing evaluations of ECCO activities to answer HEARTH learning objectives using scientifically grounded and cutting-edge methods to create a credible assessment of impacts (should an impact evaluation be chosen). The proposed evaluations of ECCO will help answer priority learning questions from the HEARTH learning agenda related to cross-sectoral benefits, attitude and behavior change, threat reduction, and biophysical impacts.

Purpose, Audience, and Intended Uses

USAID has commissioned the team to conduct an FA to generate evaluation design options that could be used to rigorously evaluate the impacts of the ECCO project. This FA was conducted through a desk review and in-person meetings with IPs. The results, data, and proposals in this FA will help USAID and its partners 1) strengthen activity design in advance of implementation to ensure the activity is in the best possible position to achieve the desired impacts; 2) provide USAID and TNC with recommendations on if an evaluation should proceed; and 3) lay out possible options for evaluations based on assessment findings. The primary audiences for this FA are USAID/Washington; USAID/Southern Africa; USAID/Angola; and TNC. Secondary audiences include IPs and other institutions working in and around the Upper Okavango. USAID will use the results of this FA to refine ECCO design and understand available design options and methods to evaluate ECCO, making a decision whether or not to move forward on an evaluation of ECCO.

Context

The ECCO project is taking place in Southeast Angola, around the northern portion of the Okavango River basin (also known as the Upper Okavango). Activities primarily focus in the Cuando Cubango province, in the communities of Menongue, Cuchi, Cuangar, and Cuito Cuanavale. In particular, the activity will be carried out around two main rivers in the Okavango River basin system (Cubango and Cuito), as seen in Figure 1. All activity sites have been identified as areas where substantial threats to biodiversity, economic, and human well-being exist due to human activity, as well as natural features such as heavy rains and poor topography for drainage. These threats include unsustainable use of forests for food and firewood; unsustainable fishing practices; current and potential development of

hydroelectric infrastructure; commercial agriculture projects; and poor water and sanitation infrastructure. Compounding this, over 90 percent of people in the identified areas are in poverty, underscoring the need for activities that improve livelihoods and maintain sustainable conservation and human well-being outcomes. The activities designed to do this, implemented by TNC and their partners, fall into three strategic objectives:

SA1: Conservation livelihoods for biodiversity, forests, and climate resilience to support communities' economic development along livelihood pathways that promote conservation of natural resources for long-term sustainability.

SA2: Water, sanitation, and hygiene (WASH) and water resource management to build capacity to advance community-led governance and management of water supply and sanitation services, integrated with targeted investment in nature-based solutions (e.g., reforestation and forest/peatland protection), to support people and nature in the Upper Okavango.

SA3: Cross-sector landscape collaboration for biodiversity, and human well-being because the sustainability of the Upper Okavango also requires attention to cross-sectoral issues that affect biodiversity, climate, and human well-being. This SA will target such issues as sustainable energy delivery and use.

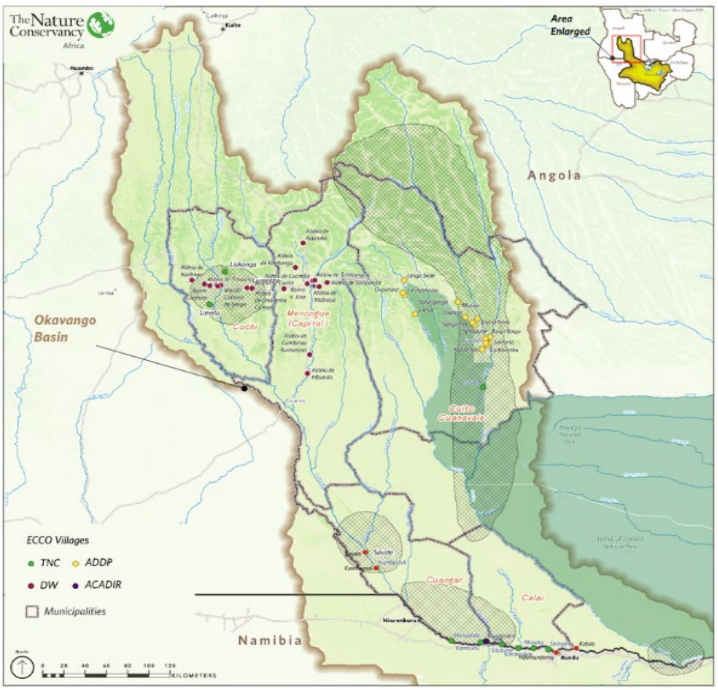

Figure 1: *ECCO Intervention Areas*

In addition to these SAs, ECCO mainstreams GESI and inclusion of youth as cross-cutting themes throughout the SAs and activity as a whole. These include strengthening institutional leadership and commitment to GESI among each IP; tracking and analyzing the participation of women and youth; fostering inclusive participation in decision making; creating an environment that enables equitable access to resources; and conducting capacity building activities.

Information Sources

The FA team consulted a variety of documents and other information sources to inform this assessment, including:

- Discussions with USAID, TNC, and other IPs - including *Associação de Conservação do Ambiente e Desenvolvimento Integrado Rural* (ACADIR), *Ajuda de Desenvolivmento de Povo para Povo* (ADPP),

Development Workshop (DW), and The Permanent Okavango River Basin Water Commission (OKCAOM);

- Detailed logic models, ToCs, and results chains specific to ECCO;
- Draft Year 1 workplan, which outlines key activities and sub-activities to take place in the first year;
- DHS Angola data;
- Reports of past, similar activities from IPs;
- Lists of intervention areas from IPs;
- Meetings and visits to possible implementation areas; and
- Literature review of academic and grey literature on conservation-based livelihoods and WASH.

Intervention and Theory of Change

The following section provides further details on the interventions planned under each of ECCO's SAs, including the IPs and the timing of activities. This is followed by a discussion of the whole of project ToC and specific results chains that we propose to inform the proposed evaluation. The FA team recommends that the whole of project ToC be updated, along with evaluation results chains at the end of project Year 1 to reflect the final implementation plans (which are still being determined for many activities); and revisiting the ToC annually and updating as necessary.

Intervention Details

The below section first provides an overview of main activities under each of the three SAs along with the primary IPs and timeline. This summary of the SAs is informed by the Year 1 workplan and also through our in-country meeting with IPs. The GESI Action Plan is still under development, but ECCO is also intended to provide more equal access to opportunities and decision-making processes for marginalized populations, particularly women and youth. The cross-cutting activities regarding GESI are planned to be implemented in all targeted communities.

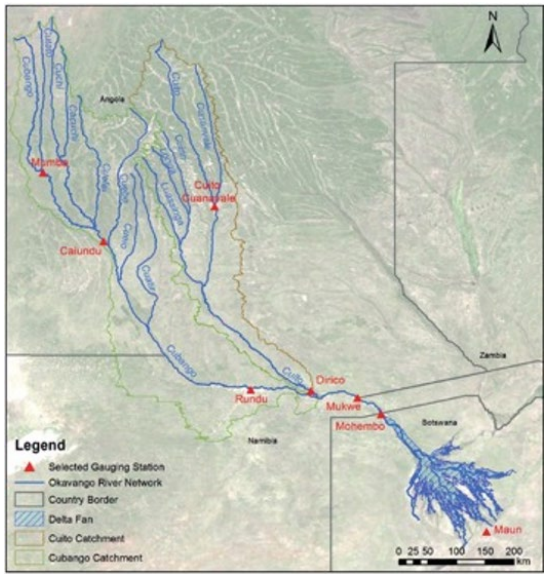

Figure 2: *Upper Okavango River Network*

SA1: Conservation livelihoods for biodiversity, forests, and Climate Resilience. SA1 includes three main components: establishing fishery cooperatives and creating more sustainable fishing populations (e.g., provision of equipment, training on fishery best practices, establishing inland fishery patrols); developing conservation agriculture practices (e.g., training on horticulture practices, procuring irrigation solar systems, providing horticulture tools and equipment); and creating awareness of the dangers of bush fires (e.g., participatory forest mapping, community education, systematic planting of trees, and organization of fire brigades).

The primary IP for these activities is ACADIR and TNC, with some support from DW and ADPP. The full suite of communities targeted to receive the activities under SA1 have not been identified. The process of creating legal cooperative structures is time-intensive, and thus ACADIR does yet not have a full list of communities. As of our in-country meetings in early September 2023, ACADIR had selected three communities within Cuangar municipality (along the Cubango River) (Figure 2). Our in-country meetings and the Year 1 workplan revealed that most of the forest conservation activities were planned in tandem with conservation agriculture activities. As a result, we

lump forest conservation activities in with the conservation agriculture activities throughout the remainder of the FA. Table 1 provides a summary of the FA team's latest understanding of where the targeted communities are planned for each SA. Notably, there is still a lot of ambiguity about where each activity will take place, particularly for ADPP. Furthermore, it is still quite unclear where the different IP approaches overlap. For example, there is still a lot of uncertainty in the different types of activities that ADPP and DW will take to promote WASH in SA2.

Table 1: Summary of Planned Activities by Municipality and IP

Municipality Name	Inland Fishery Activities (SA1)	Conservation Agriculture Activities (SA1)	WASH Activities (SA2)
Cuito Cuanavale	✓ (TNC + ADPP)	✓ (ADPP)	✓ (ADPP)
Cuangar	✓ (ACADIR)	✓ (ACADIR)	
Cuchi			✓(DW)
Menongue			✓ (DW)

SA2: Water, sanitation, and hygiene and water resource management. SA2 includes two main components: improving water access and quality (e.g., community borehole repair training, establishing group of care for water point); and reducing open defecation (e.g., creating sanitation subcommittees, developing sanitation training modules, conducting community-led total sanitation activities, and educating communities on latrine construction).

The primary IPs for SA2 are DW and ADPP, with DW working in Menongue and Cuchi municipalities, and ADPP working in Cuito Cuanavale municipality. DW has pre-identified twenty communities they will target for the water access and sanitation activities (ten in Menongue and ten in Cuchi) and ADPP has pre-identified fifteen communities that they will target for these activities in Cuito Carnavale. Our meetings in country suggested that DW was taking a more intensive approach to these activities through total-led sanitation activities and trainings, while ADPP was mostly providing educational materials and supporting ACADIR in SA1. Further, it is unclear which of ADPP's targeted communities will receive WASH interventions versus fishing and agricultural interventions. While the title of SA2 includes water resource management as a priority, the discussion of water resource management activities was absent during our in-country meetings with IPs. Further, the description of WASH sub-activities in the monitoring, evaluation, reporting, and learning (MERL) plan and Year 1 workplan were much more clearly articulated, while the water resource management sub-activities lacked sufficient detail for the FA team to consider them for evaluation.

SA3: Cross-sector landscape collaboration for biodiversity, and human well-being. This SA engages IPs to jointly develop a plan of action for capacity building and knowledge sharing and working to disperse technical tools and products among IPs. Our understanding is that all IPs will participate in SA3, with The Permanent Okavango River Basin Water Commission (OKACOM) providing training and

technical support, and DW and ADPP developing educational materials to be used in the other SAs. As a result, the activities in SA3 will inform, to some extent, most of the activities in SA1 and SA2. SA3 also involves private sector engagement in the promotion of clean cooking technologies, which is being conducted by a private sector partner, C-Quest Capital in Cuito-Cuanavale, as well as expanded microfinance access through KixiCredito, expanded household solar through SunAfrica, and collaboration on potential community REDD/forest carbon payment project through BioCarbon Partners.

Logic Models

The ToC and TNC logic models for each SA are provided in Annexes A and B. The ToC is still under development with TNC. The original ToC assumes the overlap of multiple different interventions. However, there is little overlap between communities being targeted under SA1 and SA2. Additionally, there is still uncertainty about specific locations for many interventions, particularly under SA1. There is also uncertainty about the specifics of intervention activities across all of the SAs. We expect that the details of the interventions of the SAs, as well as a more delineated implementation plan will be finalized by the end of project Year 1.

Based on the FA team's understanding of ECCO's activities during the time of this assessment, the team created three new logic models to capture specific activities in the fisheries (SA1), conservation agriculture (SA1), and WASH (SA2) domains. The team framed our evaluation questions, indicators, and evaluation design around each of these logic models, and included other potential evaluation options for SA3 in the Illustrative Evaluation Design Options and Methods section. The FA team's proposed logic models and potential outcomes were focused on the areas of the ECCO activities that were most clearly defined and articulated in the Year 1 workplan and in our visits to the country. However, the FA team recommends updating the whole project ToC and SA logic models at the completion of project Year 1. Should other activities (particularly those under SA3) become more clearly defined, the evaluation design should be updated.

Figure 3 below contains the updated logic model for SA1 fishing activities. The main activities identified by the FA team were the provision of improved fishing materials, substantial training on fishing best practices, and establishing fishery cooperatives in the targeted communities. The promotion of conservation agriculture in these villages also promotes alternative livelihood options. The use of unsustainable fishing gears and fishing year-round were found to be two of the most significant factors creating pressure for fish populations in this region.[3] As a result of both the provision of new materials (e.g., nets with larger hole sizes) and the training on appropriate sizes of fish to catch, the team expects fewer premature fish caught and more sustainable fishing practices (e.g., rotating fishermen, seasons, etc.) put into place, leading to a more sustainable fish supply. Additionally, as a result of this sustainable fish supply, community members may experience improved food security. Most fishing in this region is subsistence fishing,[4] though the fishing cooperatives in SA1 aim to sell a portion of fish catches. As a

[3] Tweedle, D. (2020). Fisheries identification and assessment to support resilient development and return on investment analysis in the Cubango-Okavango River Basin.
[4] The Nature Conservancy (2022): Okavango Upper Catchment Programme Cuito and Cubango Rivers Baseline Fish and Fisheries Assessment Literature Review.

result, revenue gained from collective cooperative management and fish sales is hypothesized to increase consumption among cooperative members. The nature of the cooperatives would involve collective management of cooperative revenues, economic empowerment for women participating in the cooperative. Without the GESI Action Plan, it is unclear what exact gender-related goals the IPs under SA1 are targeting (e.g., reach, benefit, empower, transform).[5] Upon receipt of the GESI Action Plan, the FA team can more explicitly generate gender-specific outcomes.

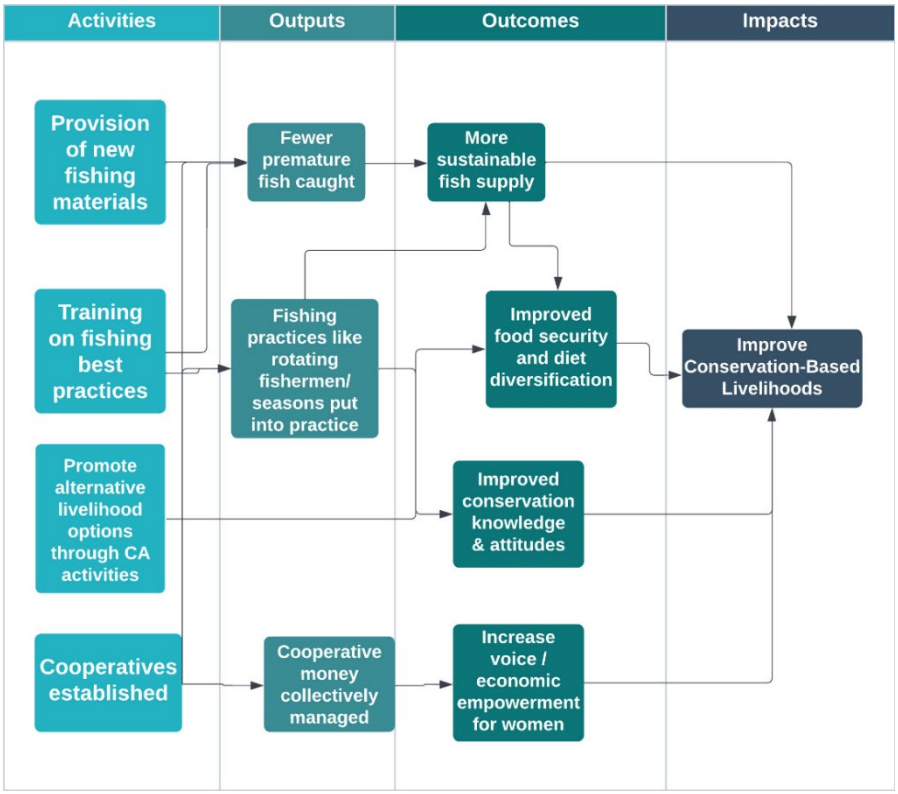

Figure 3: *Updated Logic Model of SA1 Fishing Activities*

Figure 4 shows an updated logic model of sustainable agriculture and forestry activities under SA1. The FA team split SA1 activities in this way because activities were targeting different sectors, and it was unclear if all SA1 communities are planned to receive the fishing activities (see Table 1 above). Under this part of SA1, forestry cooperatives will be established, communities will receive extensive conservation agriculture training, fruit trees will be planted, and education will take place on forest management, apiculture and bush fires. Intermediate outputs include new crops being planted, updated knowledge of agriculture and forestry management best practices, and the development of a system to collectively manage money from the sustainable agriculture cooperatives. As a result, major outcomes include increased food security and diet diversification, as well as sustainable plans for field management, such as reduced forest clearing and slash and burn. In the regions the FA teams observed, the sustainable agriculture communities were surrounded by savannah terrain. Reports from IPs indicate that other communities are surrounded by sparse woodlands. As with the fishery cooperatives, given the participation of women in the cooperatives, the collective management of revenues is hypothesized

[5] https://gender.cgiar.org/tools-methods-manuals/reach-benefit-empower-transform-rbet-framework

to increase the economic empowerment of women in the target communities. Like the discussion of the inland fish logic model, additional information from the GESI Action Plan will enable the FA team to develop more robust gendered outcomes.

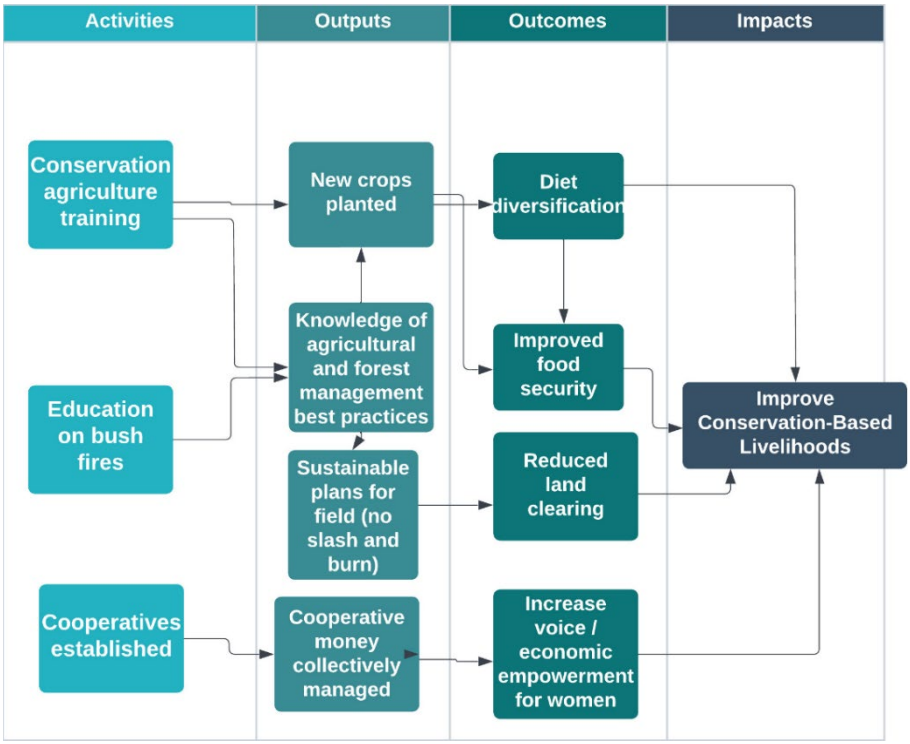

Figure 4: *Updated Logic Model of SA1 Sustainable Agriculture Activities*

Finally, Figure 5 contains the updated logic models from the proposed WASH activities in SA2. The two primary WASH activities include a community-led total sanitation campaign and training on maintenance and repair of borehole structures and sanitation structures. From the improved knowledge from these two activities, it is hypothesized that households will transition away from river water to borehole water and households will reduce open defecation and increase latrine adoption. Further, education on the link between human behavior and river water quality is hypothesized to improve attitudes about protecting water sources. The improved water quality from these behavior changes is posited to improve human health (reduce enteric infections) and potentially improve the health of river ecosystems by reducing fish exposure to contaminants, which could also lead to further human health benefits.[6][7] Reduced reliance on river water is also hypothesized to increase time savings, particularly for women. The reduction of open defecation is also proposed to improve the privacy, dignity, and empowerment of women in the targeted communities.

[6] Schar, Daniel, Zhenyu Zhang, Joao Pires, Bram Vrancken, Marc A. Suchard, Philippe Lemey, Margaret Ip, Marius Gilbert, Thomas Van Boeckel, and Simon Dellicour. "Dispersal History and Bidirectional Human-Fish Host Switching of Invasive, Hypervirulent Streptococcus Agalactiae Sequence Type 283." PLOS Global Public Health 3, no. 10 (2023). https://doi.org/10.1371/journal.pgph.0002454

[7] Ziarati, Mina, Mohammad Jalil Zorriehzahra, Fatemeh Hassantabar, Zibandeh Mehrabi, Manish Dhawan, Khan Sharun, Talha Bin Emran, Kuldeep Dhama, Wanpen Chaicumpa, and Shokoofeh Shamsi. "Zoonotic Diseases of Fish and Their Prevention and Control." The veterinary quarterly, December 2022. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9397527/

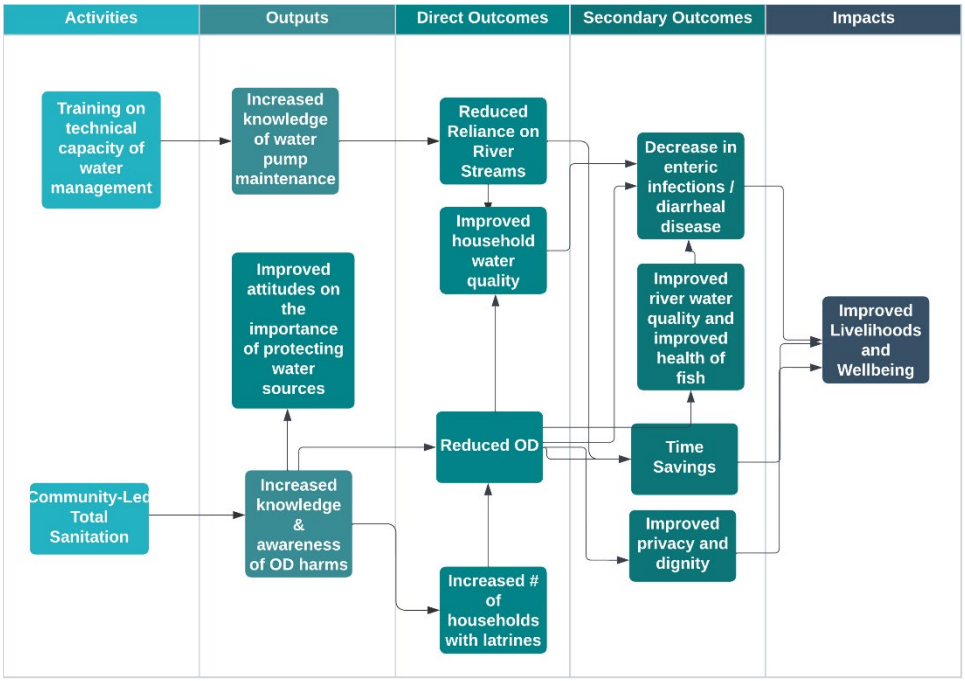

Figure 5: *Updated Logic Model of SA2 WASH Activities*

LITERATURE REVIEW

The literature review is divided into three broad categories that map onto the logic models provided above: inland fisheries, sustainable agriculture, and WASH. In each section, the focus is on the potential of interventions to provide dual biodiversity and social well-being outcomes.

INLAND FISHERIES LITERATURE

Inland capture fisheries contribute to growing levels of production, making up an estimated 11.5 percent of total global reported fish production in 2020. Of that, it is estimated that 95 percent of the catches came from developing countries.[8] However, researchers propose that these are underestimates and that the actual yield may be several times greater. Given that technical capacity is low and governance structures are poor in many of the inland capture fisheries settings, monitoring systems are often lacking. Due to the data-poor environments of many inland capture fisheries, it is difficult to characterize the state of these fisheries and their water systems.[9] As a result, much of the literature in this area focuses on how to accurately measure yields and improve data quality rather than on measuring the impacts of interventions. A discussion of different approaches to collecting fisheries data is included in the Sources and Statistical Power section.

[8] FAO (2022): The State of World Fisheries and Aquaculture 2022. https://www.fao.org/3/cc0461en/online/sofia/2022/world-fisheries-aquaculture.html
Bartley, D.M., G.J. De Graaf, J. Valbo-Jorgensen, G. Marmulla, "Inland capture fisheries: status and data issues," *Fisheries Management and Ecology,* Vol. 22, Issue 1 (2015): 71-77: https://doi.org/10.1111/fme.12104

[9] FAO (2010). *State of World Fisheries and Aquaculture.* Rome: Food and Agriculture Organization of the United Nations.

The literature establishes a strong link between inland fisheries, food security, and nutrition. More than 90 percent of reported inland fisheries are used for direct, local human consumption.[10] Inland fish are often more affordable than other animal-source foods in remote areas, thus providing an important source of nutrition for these rural populations whose livelihoods are often dependent on natural resources.[11] Researchers found that in 2015, inland fisheries provided an amount of animal protein equivalent to the full dietary consumption of at least 158 million people.[12] Further, inland fisheries provide dietary diversity that has been shown to enhance the diet quality of young children.[13]

Despite this evidence on the importance of inland capture fisheries, there is a paucity of evaluations on improvements to inland fishery management. A meta-analysis of co-management interventions[14] in developing countries did not identify any examples of rigorous ex-post impact assessment, though indicated suggestive evidence that key process and outcome indicators revealed that co-management delivers benefits to end-users.[15] The lack of high-quality impact evaluations is not unique to inland fisheries. Assessments of natural resource management initiatives are particularly difficult because of attribution issues, identification of proper counterfactuals, indirect impact pathways, and the time lag between intervention and the realization of benefits.[16] Beyond co-management, the FA team identified several case studies of inland fishery cooperatives[17] but did not identify any rigorous evaluations of fishery cooperatives in developing countries. As a result, there is little existing evidence supporting the linkage between inland fisheries management and conservation outcomes. Thus, an evaluation of the fisheries component of SA1 provides important and novel learning opportunities, though it is subject to the challenges of attributing causal effects described above.

Sustainable Agriculture Literature

Conservation agriculture is a resource-saving agricultural production system that aims to achieve production intensification and high yields through minimum mechanical soil disturbance, permanent soil organic cover with crop residues and cover crops, and species diversification. Globally, adoption of CA

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[10] FAO (2016). *The state of world fisheries and aquaculture: Contributing to food security and nutrition for all.* Rome, Italy: The Food and Agriculture Organization of the United Nations.

[11] Kawarazuka, N., and C. Bene, "Linking small-scale fisheries and aquaculture to household nutritional security: An overview." *Food Security,* Vol. 2 (2010): 343-357. https://doi.org/10.1007/s12571-010-0079-y

[12] McIntyre, P.B., C.A.R. Liermann, C. Revenga, "Linking freshwater fishery management to global food security and biodiversity conservation," *Proceedings of the National Academy of Sciences of the United States of America,* Vol. 113 (2016): 12880-12885. https://doi.org/10.1073/pnas.1521540113

[13] O'Meara, L., P. Cohen, F. Simmance, P. Marinda, J. Nagoli, S.J. Teoh, S. Funge-Smith, D.J. Mills, S.H. Thilsted, K.A. Byrd (2021), "Inland fisheries critical for the diet quality of young children in sub-Saharan Africa." *Global Food Security,* Vol. 28.

[14] Evans et al. (2011) defines co-management as: "the sharing of responsibility and authority between the state and the resource-users, but often involves collaboration between a variety of stakeholders, including different government agencies, nongovernmental organizations, private enterprises and civil society."

[15] Evans, Louisa, et al. "Assessing the impact of fisheries co-management interventions in developing countries: A meta-analysis," *Journal of Environmental Management*, Vol. 92 (2011): 1938-1949. https://doi.org/10.1016/j.jenvman.2011.03.010

[16] Waibel, H., D. Zilberman, "International Research on Natural Resources Management: Advancements in Impact Assessment," *CAB International* (2007).

[17] See, for example, FAO (2012): "Cooperatives in Small-Scale Fisheries: Enabling Successes through Community Empowerment" or Roy et al. (2018), "Knowledge and skill development of Bihar farmers on inland fisheries management: A terminal evaluation." *Indian Journal of Fisheries*.

practices has increased rapidly over the past decade.[18] In theory, CA practices reduce erosion and enhance soil health thus producing both economic and environmental benefits.[19]

Like the discussion of fisheries above, measuring impacts on conservation-related activities is methodologically challenging and can be expensive.[20] Related to conservation agriculture, challenges may include: a historical legacy of prior interventions, purposeful selection of treatment areas, hard to identify comparison areas, large variability in ecological outcomes, long time lags between intervention and ecological response, programs with multiple interventions, and data constraints.[21]

To our knowledge, there are no rigorous impact evaluations of the effect of CA practices on biophysical outcomes such as soil quality in the conservation agriculture literature. There are several before and after studies suggesting improvements to soil quality after the adoption of CA practices,[22] [23] [24] [25] however, without adequate comparison areas, it is causally difficult to attribute these improvements to CA. Beyond soil quality, there are a number of studies that explore the effect of conservation agriculture on reduced forest clearing. Minimum tillage is a key component of CA and in theory, should reduce cropland expansion due to depleted soils and thus deforestation. Two studies in Zambia found no effect of conservation agriculture adoption on forest clearing. One of these studies indicated that the demands of subsistence food requirements led to continued expansion even with conservation agriculture techniques. [26]The other study indicated that in cases where conservation agriculture increased yields, farmers were actually more likely to expand croplands because of the potential for greater economic returns.[27] This finding suggests that the potential impact of more efficient agricultural land is ambiguous. On the one hand, it might encourage less cropland expansion as farmers are able to increase yields on existing land; on the other hand, it might result in increased cropland expansion as the economic returns for such expansion are now higher. Both studies used IE methodology (double-hurdle

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[24] Nandan, Rajiv, Vikaram Singh, Sati Shankar Singh, Virender Kumar, Kali Krishna Hazra, Chaitanya Prasad Nath, Shispal Poonia, Ram Kanwar Malik, Ranjan Battacharryya, Andrew McDonald, "Impact of conservation tillage in rice-based cropping systems on soil aggregation, carbon pools and nutrients," *Geoderma,* Vol. 340 (2019): 104-114, https://doi.org/10.1016/j.geoderma.2019.01.011
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[26] Ngoma, H., J. Pelletier, B.P. Mulenga, M. Subakanya. (2021). "Climate-smart agriculture, cropland, expansion and deforestation in Zambia: Linkages, processes and drivers." Land Use Policy, Vol. 107.
[27] Ngoma, H., A. Angelsen (2018). "Can conservation agriculture save tropical forests? The case of minimum tillage in Zambia." Forest Policy and Economics, Vol. 97: 153-62.

models and instrumental variables) to address potential endogeneity. However, we note that both studies were conducted in Zambia and the intensity of the CA-promotion activities is unclear.

The FA team identified a number of evaluations that attempt to measure the effect of CA practices on socioeconomic outcomes. To address issues of selection and endogeneity, most of these studies either rely on matching,[28] [29] endogenous switching regression techniques,[30] or instrumental variables.[31] Taken together, these studies provide evidence of positive gains to agricultural yields as well as economic outcomes such as household income.

The FA team posits that developing a causal understanding of conservation agriculture on biophysical outcomes (such as soil quality and forest clearing) as well as exploring new socioeconomic outcomes (such as food security and women's empowerment) provides several new learning opportunities.

WATER, SANITATION, AND HYGIENE LITERATURE

WASH interventions are well-studied in the impact evaluation literature.[32] In the inland fisheries and conservation agriculture literature, the challenge was designing and implementing rigorous evaluations while the challenge in the WASH literature is obtaining reliable measurements of impacts. Common outcomes explored in WASH evaluations include child health and time savings benefits, though recent literature has also begun to explore nutrition and cognitive benefits.[33] The literature on the effects of WASH interventions on child diarrhea shows mixed results.[34] [35]WASH evaluations that show minimal effect on child diarrhea often do not achieve high enough levels of service[36] or adequate levels of coverage. More recently, research has questioned the use of self-reported diarrhea as a reliable

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[34] Freeman, Matthew C., Joshua V. Garn, Gloria D. Sclar, Sophie Boisson, Kate Medlicott, Kelly T. Aleander, Gauthami Penakalapati, Darcy Anderson, Amrita G. Mahtani, Jack E.T. Grimes, Eva A. Rehfuess, Thomas F. Clasen. "The impact of sanitation on infectious disease and nutritional status: A systematic review and meta-analysis," *International Journal of Hygiene and Environmental Health,* Vol. 220, Issue 6 (2017): 928-949

[35] Cumming, Oliver, Benjamin F. Arnold, Radu Ban, Thomas Clasen, Joanna Esteves Mills, Matthew C. Freeman, et al. "The implications of three major new trials for the effect of water, sanitation and hygiene on childhood diarrhea and stunting: a consensus statement," BMC Medicine, 17 (2019). https://doi.org/10.1016/j.ijheh.2017.05.007

[36] Wolf, Jennyfer, Sydney Hubbard, Michael Brauer, Argaw Ambelu, Benjamin F. Arnold Robert Bain, et al., "Effectiveness of interventions to improve drinking water, sanitation, and handwashing with soap on risk of diarrhoeal disease in children in low-income and middle-income settings: a systematic review and meta analysis," *The Lancet,* Vol. 400, Issue 10345 (2022); 48-59. https://doi.org/10.1016/S0140-6736(22)00937-0

outcome. Not only are self-reports subject to measurement error, but it is also subject to misclassification error with respect to enteric infection, due to the existence of non-infectious diarrhea and asymptomatic enteric infection.[37] Furthermore, stool sampling has demonstrated that self-reported diarrhea is a poor proxy for enteric pathogen presence.[38]

Most of the literature on WASH and time savings focuses on reduced water collection times due to water supply interventions. The average reported time savings across 32 of such studies was 75.8 minutes per household day, with most of those time savings being accrued to women.[39] However, there is substantial variation in the estimated time savings that evaluations attribute to WASH interventions. This variation could be, in part, due to the measurement of time savings. Time savings are typically elicited in one of three ways. The first, the time diary approach, aims to have an individual reconstruct time use on a recent day. The second, direct questioning, asks respondents to estimate the time spent on a specific activity in a recent or typical time period. Finally, more recent research has begun to use Global Positioning Systems and smartphones to track information related to individuals' movements throughout the day, which is then used to determine locations relative to mapped community water and sanitation facilities.[40] Notably, the broader development literature has recently questioned the validity and reliability of time use data. High-quality time use data is difficult and costly to collect, creating threats of attrition and measurement error.[41] Other challenges in time use data collection in developing country contexts include lower literacy rates and higher incidences of passive caregiving and multitasking.[42]

Beyond these measurement challenges, also relevant to the ECCO evaluation is that there are no rigorous evaluations to the FA team's knowledge of the impact of WASH interventions on biophysical or biodiversity outcomes. The link between WASH and these outcomes is more tenuous than the SA1 activities. In theory, reduced open defecation near river and stream water should reduce fecal coliforms in those water sources, thus improving water quality. Further, some pathogens which are transmitted via feces have been found to have critical consequences for the health of both humans and fish. Bacteria from the *streptococcaceae* family can be transmitted bi-directionally between humans and fish, with

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[42] Hirway, I, "Time-use surveys in developing countries: An assessment." In: Unpaid Work and the Economy: Gender, Time Use and Poverty in Developing Countries. Palgrave Macmillan UK, London pp. 252-324. http://dx.doi.org/10.1057/9780230250550_11.

studies citing that WASH interventions can disrupt this cycle.[43] In humans, *streptococcaceae* can cause a myriad of diseases, including neonatal sepsis and meningitis; and in fish, can cause encephalitis, disorientation, hemorrhagic skin, and death –depleting fishery stocks.[44] Bacteria from the *Vibrionaceae* family, such as Cholera, have also been seen to have critical effects on the fish population – with Vibrio-infected fish often suffering from lethargy, skin legions, and eventually death. Several other bacteria have also been seen to have health effects in both fish and humans, with transmission possible between the two; with many others being asymptomatic in fish but causing disease among humans. Parasitic and viral diseases have also been seen to affect fish health, though on a lesser scale than that of bacteria. It is also critical to consider the threat of growing antimicrobial resistance, either through anti-microbial resistant pathogens entering the river system and spreading (through environmental vectors); or anti-microbials themselves entering the river system and resulting in the evolution of anti-microbial resistant pathogens. As such, improving water quality has the potential to improve the biodiversity and health of these rivers; and by extension human health.[45][46] However, these impacts have not yet been assessed and thus the link is tenuous at best, but may still present a potentially interesting learning opportunity from the ECCO evaluation to consider how WASH interventions intersect with river health. While there is some literature exploring fecal exposure on biophysical river outcomes,[47] [48] the FA team will note that these outcomes were not incorporated as part of the initial SA2 theory of change or logic models. As such, if this is an avenue that USAID would like to pursue, additional information from IPs would be necessary as soon as possible to make an ultimate determination on feasibility. Specifically, we would need to know how many SA2 communities are located next to rivers to determine if we would have sufficient power. We would also need to know the extent of livestock fecal contamination which would affect the likelihood of observing results. Finally, we would need to know appropriate biophysical indicators for the river ecosystems considered, though we believe that eDNA options may be the best avenue to pursue. This information could be gathered through an additional scoping trip if IPs were not able to provide it in a timely manner.

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Illustrative Evaluation Questions

The FA team focused on key learning questions of interest to USAID. At a high-level, these learning questions concern the impacts of ECCO on human well-being (socio-economic status, food security, health, etc.) and improvements to biodiversity and conservation. Below is a set of simplified core questions that the FA team used to frame the evaluation design options:

To what extent does each SA (or combinations of SAs):

- Decrease stress on and reduce threats to biodiversity, and improve biophysical conditions
- Change behavior, knowledge, and norms around conservation
- Affect livelihoods, well-being, and rural poverty
- Affect human health
- Have differential effects for certain subgroups (particularly women, but also youth and those in extreme poverty)
- Achieve sustainable outputs, outcomes, and impacts

In addition to the core evaluation questions, the FA team will address more specific research questions depending on the final evaluation approach for each SA in the evaluation design report. The team includes some illustrative research questions throughout the remainder of the FA where the team feels that there are particularly strong learning opportunities. It should be emphasized that the feasibility of answering certain evaluation questions using impact evaluation or performance evaluation methods will, in large part, be determined by factors such as the development of implementation plans, availability of counterfactual and comparison groups, and available budget and resources. The constraints and proposed evaluation design options are described in more detail in Design Options and Methods.

The FA team is proposing three evaluation components that map onto the logic models included in the preceding section: fisheries (SA1), sustainable agriculture (SA1), and WASH (SA2). In terms of examining evaluation questions related to integration or interaction between activities and SAs, at present, it does not appear that there is significant interaction between SA1 and SA2. SA2 is being implemented in some villages where ACADIR had formerly implemented activities like those being planned under SA1; however, within ECCO, there is no current planned overlap between the communities being targeted for SA1 and SA2. Currently, there is still a lack of clarity on the degree of overlap between SA1 communities receiving agriculture/forestry interventions and communities receiving fisheries interventions. The FA team will continue to explore opportunities to examine questions related to the integration of the different SAs as the implementation plans are finalized. For SA3, the FA team recommends a performance evaluation and case study approach to study the effectiveness of engaging the private sector as well as how information sharing and learning between IPs affected the success of SA1 and SA2. The case study approach can identify and explore different dimensions of successful private sector engagement. Specifically, we will be interested in exploring conditions that facilitate private-sector engagement and the extent to which private-sector engagement contributes to SA1 and SA2 outcomes.

Sources and Statistical Power

This section first provides an overview of illustrative outcomes for each of the three evaluation components with proposed data sources (Table 2). Given the extremely data poor environment in Angola, we do not find a substantial number of data sources to measure performance and impact indicators, and thus the FA team recommends relying heavily on household surveys. Where possible, the FA team identified outcomes that overlapped with the USAID HEARTH Monitoring and Evaluation Toolkit. It should be noted that at a minimum, the FA team will report data disaggregated by key marginalized groups identified by the activity (e.g., lower and higher socio-economic status, men and women, and youth). Additionally, for each proposed evaluation component, the SA team has included relevant gender inclusion and empowerment outcomes. Finally, this section explores statistical power and implications for the evaluation design.

Fisheries Evaluation (SA1) Potential Outcomes

Table 2: *SA1 Fishing Activities Illustrative Outcomes and Indicators*

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
Conservation Knowledge and Attitudes	Knowledge of sustainable fishing practices	Awareness of patrol penalties	Household surveys
		Knowledge scale of fishing best practices	Household surveys
	Perceived importance of conserving nature	Average score measuring the perceived importance of conserving nature and the environment (with particular emphasis on importance of sustainable fish supply and biodiversity of fishery)	Household surveys
Conservation Practices/ Behavior	Improved sustainable fishing practices	Percent of households participating in fishery cooperatives	Household surveys
	Improved sustainable fishing practices	Use of promoted fishing gear, tool, and practices	Household surveys

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
Food Security and Nutrition	Increased dietary diversity	Percent of women of reproductive age consuming a diet of minimum diversity (MDD-W)	Household surveys
	Improved individual or household food security	Percent of households experiencing moderate and severe food insecurity, based on the Food Insecurity Experience Scale	Household surveys
Socio-economic Well-being	Increased socio-economic status	Percent of households below the comparative threshold for the poorest quintile of the Asset-Based Comparative Wealth Index	Household surveys
		Change in per capita household consumption / expenditures in key areas such as health, education, etc.	Household surveys
	Increased benefits from nature-based economic activities	Revenue reserves of cooperatives	Village cooperative survey
		Cooperative revenue sold from fish sales in past week/month	Household surveys; Village cooperative survey
		Average household income from fishery sales in the past week/month	Household surveys
Gender Inclusion	Women participation in cooperatives	Percent of cooperative members that are women	Household surveys; Village cooperative survey
		Percent of cooperative leadership that are women	
		Percent of women participants at last cooperative meeting	Village cooperative survey

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
	Women empowerment	Percent of women achieving high empowerment on Survey-based Women's Empowerment Index (SWPER)	Household surveys
Biophysical outcomes	Reduced premature fish caught	Average size of fish caught	Dependent Monitoring Data
	Proxy of fish stock	Average number and type of fish caught, by season	Dependent Monitoring Data

The FA team proposes the use of household surveys and surveys at the cooperative level to measure outcomes related to food security, socio-economic well-being, and gender and social inclusion.

Since the number of villages being targeted is small relative to the total use of the river basin, the FA team believes that the ToC may be overly optimistic on the impact on system-wide fish reserves. Given the number of targeted villages relative to the number of villages along the river basin as a whole, the FA team does not believe that the activity will likely change the biodiversity of the fish populations in a measurable way. For this reason, the FA team does not recommend the use of independent fisheries monitoring either through Fisheries Independent Survey techniques or through the use of Earth observation data, which are most likely to identify system wide effects.[49] Rather, the FA team recommends the use of dependent fisheries surveys to measure changes in local fishermen practices to assess whether more sustainable practices are being used. The FA team believes that such behavior change is still an important indicator to measure in this context given the dearth of literature on inland fishery interventions. In addition, the FA team recommends using Dependent Fisheries Surveys, which is a form of self-reporting on catch size. Since TNC and ACADIR are using eCAS (an electronic Catch Assessment Survey) in all targeted villages as part of a dependent fisheries surveys, the FA team recommends using the TNC/ACADIR eCAS data to reduce the burden on villagers of having to collect the same data multiple times. This method would still allow the evaluation to measure biophysical outcomes such as catch size, an indicator of fish stocks, and size of fishes in a catch, an indicator of maturity of fish in the river. If an impact evaluation design approach is used, similar eCAS data collection methods would also need to be deployed in the selected control communities.

[49] We outline these different approaches further in Annex C.

SUSTAINABLE AGRICULTURE (SA1) EVALUATION POTENTIAL OUTCOMES

Table 3: *SA1 Fishing Sustainable Agriculture Illustrative Outcomes and Indicators*

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
Conservation Knowledge, Attitudes and Practices	Perceived importance of conserving nature	Knowledge scale of forest management	Household surveys
		Percent of households that cleared land for cultivation in the past year and/or percent of households that plan to clear land for cultivation in upcoming years	Household surveys
		Average score measuring the perceived importance of protecting nature and the environment	Household surveys
Agriculture and Land	Adoption of sustainable /conservation agriculture	Average crop production, by targeted high-value crop	Household surveys
		Average crop yield, by targeted high-value crop	Household surveys
		Number of hectares under sustainable management practices	Household surveys / Village surveys
		Percent of households participating in forestry cooperatives	Household / Village surveys
		Use of promoted agricultural technologies	Household surveys
Food Security and Nutrition	Increased dietary diversity	Percent of women of reproductive age consuming a diet of minimum diversity (MDD-W)	Household surveys
	Improved individual or household food security	Percent of households experiencing moderate and severe food insecurity, based on the Food Insecurity Experience Scale	Household surveys

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
Biophysical outcomes	Improved soil quality	Change in land capability classification (LCC)	Soil quality testing
Socio-economic Well-being	Increased socio-economic status	Percent of households below the comparative threshold for the poorest quintile of the Asset-Based Comparative Wealth Index	Household surveys
		Change in per capita household consumption / expenditures in key areas such as health, education, etc.	Household surveys
	Increased benefits from nature-based economic activities	Revenue reserves of cooperatives	Village cooperative survey
Gender Inclusion	Women participation in cooperatives	Percent of cooperative members that are women	Household surveys; Village cooperative survey
		Percent of cooperative leadership that are women	
		Percent of women participants at last cooperative meeting	Village cooperative survey
	Women empowerment	Percent of women achieving high empowerment on SWPER	Household surveys

The FA team proposes to extensively use household and village cooperative surveys to measure outcomes and impacts related to the sustainable agriculture cooperative activities under SA1. Household surveys can capture measures of food security, dietary diversity, socioeconomic outcomes and women participation and empowerment attributable to changes in conservation agriculture and cooperative participation (Table 3). Given the literature review suggesting impacts of conservation agriculture on soil quality, the FA team proposes soil testing using LandPKS at various points within each community.[50] Beyond soil quality, the FA team recommends using household surveys to capture the effects of SA1 on land clearing. As stated in the CA and forestry logic model, a projected outcome of SA1 is reduced slash and burn. Participatory forest mapping and forest management training in tandem

[50] USAID HEARTH Monitoring and Evaluation Toolkit provides more information on LandPKS and soil testing procedures.

with the promotion of more sustainable field practices is theorized to reduce unsustainable land clearing practices. Household surveys can capture recent land clearing practices as well as future land clearing plans. Given the small scale of SA1, the FA team believes it is unlikely that changes to forest area will be detectable and attributable to the project through remote sensing. However, the FA team does believe that household survey questions both about land clearing and about attitudes towards the importance of protecting nature and the environment will adequately capture important measures of success for this intervention.

Water, Sanitation, and Hygiene (SA2) Evaluation Potential Outcomes

Table 4: *SA2 WASH Activities Illustrative Outcomes and Indicators*

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
WASH Knowledge and Attitudes	Knowledge and awareness of open defecation harms	Open defecation attitudinal and knowledge scales	Household surveys
	Demand for improved sanitation	Willingness to pay for improved sanitation, by gender	Household WTP study
	Perceived importance of protecting nature	Average score measuring the perceived importance of protecting nature and the environment	Household surveys
WASH Behaviors	Latrine use and open defecation behaviors	Percent of households with a latrine	Household surveys
		Percent of household members within a household using the latrine regularly within the past week	Household surveys
		Percent of households with at least one member practicing open defecation in the past week	Household surveys
	Improved water source use	Percent of households using boreholes	Household surveys
		Percent of households using river / streams (or other unsafe sources)	Household surveys

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
		# of boreholes in operation and # of boreholes broken in the past week	Household/village surveys
Water quality	Water quality of rivers / streams	Presence / absence of fecal coliforms in freshwater and surface water sources	Village water quality testing
			Village water quality testing
	Household water quality	Presence / absence of fecal coliforms in household water storage containers	Household water quality testing
Human health	Self-reported diarrhea	Percent of children under five with diarrhea in the past two weeks	Household surveys
	Enteric infection incidence	Percent of children under five indicating enteric infection through stool sampling	Stool sampling
Socio-economic Well-being	Reduced water insecurity	The Household Water InSecurity Experiences (HWISE) scale[51]	Household surveys
	Increased socio-economic status	Percent of households below the comparative threshold for the poorest quintile of the Asset-Based Comparative Wealth Index	Household surveys
		Change in per capita household consumption / expenditures in key areas such as health, education, etc.	Household surveys
	Increased time savings	Hours spent on household labor in the past day	Household surveys

[51] The HWISE scale measures universal experiences of household water insecurity across low and middle-income countries. See Young, Sera, Godfred O Boateng, Zeina Jamaluddine, Joshua D. Miller, Edward A. Frongillo, Torsten B. Neilands, Shalean M.Collins, Amber Wutich, Wendy E. Jepson, Justin Stolder, "The Household Water InSecurity Experiences (HWISE) Scale: development and validation of a household water insecurity measure for low-income and middle-income countries," *BMJ Global Health,* Vol. 4, Issue 5 (2019). http://dx.doi.org/10.1136/bmjgh-2019-001750

Outcome Type	Illustrative Outcomes	Potential Indicators	Proposed Data Source(s)
Gender Inclusion	Agency and resources related to sanitation	ARISE scale[52]or Empowerment in water, sanitation, and hygiene index[53]	Household surveys
	Women empowerment	Percent of women achieving high empowerment on SWPER	Household surveys

The FA team is proposing household surveys to assess measures of attitudinal and behavior change, socio-economic outcomes, and improvements of gender inclusion (Table 4). The proposed outcomes include two specific scales, HWISE and The Agency, Resources, and Institutional Structures of Sanitation-related Empowerment (ARISE), that are designed to capture multidimensional measures of household water security and WASH-related women's empowerment, respectively. As noted in the literature review, there are substantial challenges to measuring time use. However, time savings resulting from this intervention, particularly from reduced water collection time, is an important potential benefit to consider, especially for women who typically bear the burden of water collection. The FA team proposes using a new module developed to simplify and shorten the time use section of household surveys in developing countries. This module uses tokens to represent segments of time across three broad categories: paid work, household or unpaid work, and leisure. With this survey module, changes to both water collection times and caregiving would be reflected within the household or unpaid work category. This module has been field validated and shown to be a reliable measure of time use and to significantly reduce the survey time spent on eliciting time use.[54] Given the central location of boreholes in these villages, providing repairs through this intervention has the potential to save women a lot of water collection time. Thus, the FA team posits that increased time savings is an important hypothesized mechanism to increased socio-economic status in this intervention.

Given the issues raised with self-reported diarrhea as a health outcome raised in the literature review above, the FA team strongly recommends stool sampling in a subsample of young children to test for the effects of the intervention on enteric infection. Doing stool sampling as part of a larger IE would not only be an important and novel contribution to the literature but would also serve as a much more accurate measure of the health impacts of the WASH activities. Recent research suggests that rapid diagnostic tests can be used as a relatively low-cost and low-tech option to test for enteric

[52] The Agency, Resources, and institutional Structure for Sanitation-related Empowerment represent 16-subdomains of sanitation-related empowerment and are the only psychometrically validated metrics for women's empowerment in WASH. See Sinharoy, Sheela, S., Shauna McManus, Amelia Conrad, Madeleine Patrick, Bethany A. Caruso, "The Agency, Resources, and Institutional Structures of Sanitation-related Empowerment ARISE Scales: Development and validation of measures of women's empowerment in urban sanitation for low- and middle-income countries," *World Development,* Vol. 164 (2023). https://doi.org/10.1016/j.worlddev.2023.106183

[53] The EWI index (Empowerment in water, sanitation, and hygiene) index measures agency, participation, and empowerment in the WASH sector. It includes a range of indicators at the individual, household, and societal level.

[54] Field, E., Rohini Pande, Natalia Rigol, Simone Schaner, Elena Stacy, Charity Troyer Moore, "Measuring time use in rural India: Design and validation of a low-cost survey module," *Journal of Development Economics,* Vol. 164 (2023). https://doi.org/10.1016/j.jdeveco.2023.103105

infections.[55]As mentioned in the literature review above, many of the pathogens tested for in the human stool sampling can also be transmitted to fish populations. However, given the tenuousness of this link as well as the fact that not all of the SA2 villages are located near rivers, it is unlikely that there will be sufficient power to detect measurable changes and so the FA team does not recommend directly testing fish specimens as part of this evaluation. Rather, the FA team suggests that this potential link provides additional support for stool sampling in this context as one could also interpret human health in this context as a potential correlate of broader ecosystem health as well.

As stated in the literature review, the FA team is not aware of an evaluation in the WASH literature that explores the link between WASH interventions and biophysical outcomes. Evaluating the effectiveness of SA2 WASH activities on surface water quality would contribute an important new line of research to the WASH knowledge base. While water quality testing can be expensive and require laboratory space, recent research suggests new, low-cost and field-ready tests that accurately capture fecal coliforms.[56] To assess whether water quality changes have affected broader river ecosystems, recent advances in e-DNA testing provide a comprehensive way to measure changes in eukaryotic biodiversity.[57] However, not all planned SA2 villages are along rivers and laboratory space in this region might pose a major constraint. Thus, rather than e-DNA testing, the FA team proposes simpler less laboratory-intensive water quality testing of fecal coliforms. If USAID is particularly interested in e-DNA as an option, the FA team would recommend a fuller scoping of laboratory capabilities as well as a better understanding of how many SA2 villages are located along a river. The FA team also recommends conducting water quality testing at the household level to test whether the borehole repair component of the project contributed to improved household water quality. Since part of the WASH activities also emphasize education on how human behavior affects river ecosystems, the FA team also proposes incorporating questions about perceived importance of protecting nature into the household surveys, which would establish a new link about how WASH activities may change attitudes about ecological protection.

Finally, the FA team recommends a willingness-to-pay (WTP) study for improved sanitation by gender. While WTP studies are common in this literature, the FA team proposes to include a WTP module in this evaluation component for two main reasons. First, the IPs are targeting a very ambitious level of latrine coverage through this intervention (95 percent). In the case that such high coverage is not achieved, it may mute effects in other outcomes of interest such as child health and water quality. However, it is possible that even if high levels of latrine coverage are not achieved, demand for improved sanitation still may have increased and a WTP study would capture such changes. Second, the FA team believes that conducting the WTP study by gender would create a novel contribution to the WASH and gender literature. While there is suggestive evidence of differing demand for sanitation by

[55] Watson, S., Mohammed Atique Alam, Ryan Rego, Richard Lilford, Ashok Kumar Barman, Baharul Alam, Faruque Sirajul Islam, "Low cost and realtime surveillance of enteric infection and diarrhoeal disease using rapid diagnostic tests: A pilot study," *medRxiv preprint* (2022), https://doi.org/10.1001/2022.03.07.22271752

[56] Brown, J., A. Bir, and R.E.S. Bain. "Novel Methods for Global Water Safety Monitoring: Comparative Analysis of Low-Cost, Field-Ready E. coli Assays." npj Clean Water 3, 9 (2020). https://doi.org/10.1038/s41545-020-0056-8

[57] Deiner, K., E.A. Fronhofer, E. Machler, J-C. Walser, and F. Altermatt. "Environmental DNA Reveals that Rivers are Conveyer Belts of Biodiversity Information." *Nature Communications* 7 (2016).

gender,[58] such differences have never been explicitly measured in the literature.[59] Furthermore, since the community-led total sanitation component of the intervention is intended to have gender-mainstreaming in its approach, measuring gender-differentiated WTP can also assess whether the intervention had differential demand impacts by gender.

STATISTICAL POWER

This section includes an analysis of statistical power related to outcomes such as well-being, livelihoods, behavioral change, knowledge and attitudes, health, and gender empowerment, followed by similar considerations for biophysical outcomes.

INDIVIDUAL, HOUSEHOLD, AND GROUP-LEVEL OUTCOMES

ECCO is a cluster-based intervention, whereby a group (cluster) of households comprising a community will be exposed to one, or a combination, of the interventions or strategic approaches. The package of activities is expected to impact individuals, households,[60] and the community. For clustered interventions, the total number of clusters in the IE sample is the most important factor for determining the statistical power of the IE design. Statistical power helps control the likelihood of a false negative—in other words, concluding that the program did not have an impact when it did. Increases of power (or more confidence in measuring a statistically significant difference between treatment and comparison areas when, in fact, a difference exists) require a larger sample size and result in a smaller minimum detectable effect size, all else equal.

Generally, IEs of cluster-based interventions can be underpowered when there are a limited number of available treatment clusters (as larger sample sizes will result in larger statistical power) and when there is more heterogeneity (i.e., variation) across clusters. Given that each intervention only occurs within one or two municipalities, the FA does not believe there will be substantial heterogeneity across clusters. However, the FA team does anticipate that the total number of targeted clusters may be a limiting factor to detecting effects. Based on in-country consultations and the Year 1 workplan, DW is planning to target 20 communities for SA2 WASH activities. There is no target yet for the number of communities targeted for SA1 fishery and sustainable agriculture activities but based on the Year 1 targets (eight total communities), the team tentatively anticipate the total number of communities targeted for SA1 to be between 30 and 50. The FA team requested from TNC and IPs summary lists of community and village characteristics for all villages within municipalities targeted through ECCO, but have still not received this information.[61] As a result, the FA team is unable to conduct a preliminary

[58] Pakhtigian, Emily., Katherine Dickinson, Jennifer Orgill-Meyer, Subhrendu Pattanayak, "Sustaining latrine use: Peers, policies, and sanitation behaviors," *Journal of Economic Behavior and Organization,* Vol. 200 (2022): 223-242. https://doi.org/10.1016/j.jebo.2022.05.024

[59] Note similar studies examining WTP by gender in other environmental health domains such as demand for improved cookstoves have found substantive differences by gender. See, for example: Miller, Grant and Mushfiq Mobarak," Gender Differences in Preferences, Intra-Household Externalities, and Low Demand for Improved Cookstoves," *NBER Working Paper,* No. 18964 (2013).

[60] Note that for some implementation activities, such as the establishment of fishery cooperatives, not all households in a program community might directly benefit from activities.

[61] TNC and IPs did provide the list of basic demographic / geographic variables for villages currently being targeted within ECCO and indicated they would need to obtain a full list of villages within ECCO municipalities from local government officials.

assessment of the similarity of program and non-program villages. The FA team will require these summary lists prior to finalizing evaluation designs.

The FA team has conducted preliminary power calculations to determine the minimum detectable effect sizes (MDES)—the smallest program impact that the evaluation can confidently detect through statistical analysis—for different sample sizes and evaluation design options.[62] It is important to consider the MDES and whether it is in line with policy and program expectations. For example, if the evaluation is powered only to detect impacts larger than realistically expected given the planned activities, it is more likely that the results will not be statistically significant. Therefore, if the MDES is larger than expected program impacts, other designs or evaluation approaches should be considered.

The FA team conducted power calculations for measuring outcomes at both the individual/household level and cluster/group level. Figure 6 below illustrates the relationship between the MDES and the number of clusters for a variety of different sampling scenarios for individual and household level outcomes, varying the number of households surveyed per community (n) from 10 to 40 and varying the intra-cluster correlation (rho) from 0.1 to 0.3.[63] Currently, for SA2, the number of clusters in the treatment arm is 20 and the number of clusters for SA1 is estimated to be between 30 and 40. The number of clusters included has a large impact on MDES. Increasing the number of households surveyed per community has a smaller effect on MDES, particularly above 30. However, there is a benefit of increasing sample size above this level for the ability to measure differential impacts across subgroups. Assuming low intra-cluster correlation, the IE would be powered to detect moderate effect sizes between 0.26 and 0.5 standard deviations.

[62] The FA team conducted power calculations using Stat's clustersampsi command. Parameters: power = 0.80, alpha = 0.05. The FA team also accounted for 15 percent attrition, and 25 percent correlation within baseline values or other predicative covariates and the outcome.

[63] The intra-cluster correlation coefficient measures the relatedness/similarity of responses within a cluster. The higher the coefficient, the more similar households are within a community on key characteristics or outcomes and the higher the required sample size.

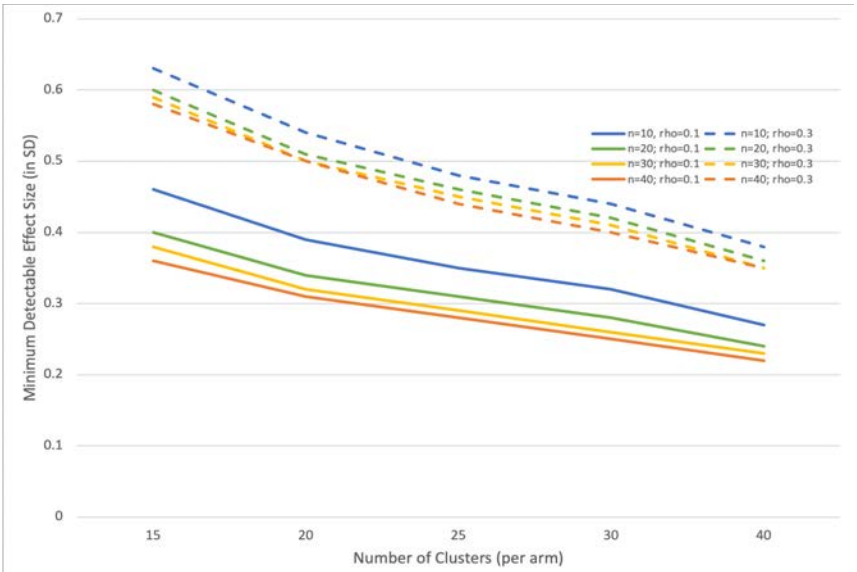


Figure 6: *Relationship between MDES and Number of Clusters - Household Level Outcomes*

Generally, the IE will not be powered to detect as small program impacts for the group level as it is for the household level (see Figure 7 below). Since group level outcomes have only one observation per given period, the MDES for 20 treatment clusters is 0.91 standard deviations, which is quite large. The ECCO activities would need to have very large impacts on community level outcomes to be able to distinguish real impacts from zero. Given that many of the biophysical outcomes discussed in the preceding section would be measured at the community level, it is important to note that there would need to be large impacts for them to be detectable.

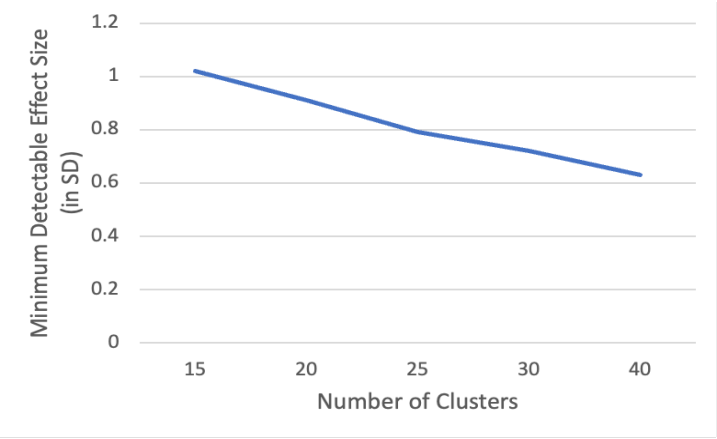


Figure 7: *Relationship between MDES and Number of Clusters - Group Level Outcomes*

Given the low degree of overlap between SA1 and SA2 communities, separate evaluations of each of these SAs will likely be needed. Table 5 below indicates the MDES for illustrative sample sizes. Columns 1 and 2 represent the 20 target intervention communities that DW is planning to work with under SA2. Columns 3 and 4 represent an estimate of 40 target intervention communities for SA1.

Table 5: *MDES for Different Sample Sizes, Matched Comparison Group DiD Design*

Minimum Detectable Effect Sizes for Different Sample Sizes				
	(1)	**(2)**	**(3)**	**(4)**
Number of communities				
ECCO activity group	20	20	40	40
Comparison group	20	20	40	40
Total communities	40	40	80	80
Number of households per community[c]	10	30	10	30
Total Household sample size[c]	400	1200	800	2400
MDES for individual/household level outcomes[a,b]	0.47	0.42	0.33	0.30
MDES for community level outcomes [a,b]	0.91	0.91	0.63	0.63

Notes:
[a]MDES = Minimum detectable effect size (calculated in unites of standard deviation from the mean)
[b]Calculations assumed a confidence level of 95 percent, two-tailed tests, 80 percent power, 15 percent attrition, 25 percent correlation with baseline values or other predicative covariates and the outcome, and 0.2 intra-cluster correlation coefficient.
[c]The number of households surveyed for the evaluation sample, not the total number of anticipated beneficiaries

To place the MDES in context to assess what effect sizes are realistic given the targeted ECCO outcomes, the FA team analyzed data from the 2015-16 Demographic and Health Surveys in Angola to contextualize the MDES for different key outcomes of interest. Given the DHS focus, most of the chosen outcomes are more relevant for SA2 than SA1. Data were restricted to the Cuando Cubango province. The effect sizes shown in Table 6 represent percentage points and not percentage change. For example, assuming a baseline mean of 11 percent of children experiencing diarrhea in the past two weeks, design options with 40 total communities would only be able to detect a decrease of 11 or 10pp (which is almost a 100 percent decrease from baseline, which is very large and likely unrealistic). It should be noted, however, that this analysis is purely illustrative, as baseline values in the program and comparison areas are expected to deviate from the province-level DHS data.

Table 6: *MDES Contextualized for Key Individual and Household Level Outcomes using DHS Angola Data*

MDES Contextualized for Key Individual and Household Level Outcomes[b]					
	Mean[c]	**(1)**	**(2)**	**(3)**	**(4)**
MDES (in Significant Differences) for household level outcomes[a]		0.47	0.42	0.33	0.30
Child diarrhea in past 2 weeks	0.11	0.11	0.10	0.08	0.08
Takes 30 minutes or more to collect water	0.43	0.22	0.20	0.16	0.14
Access to improved water source	0.32	0.23	0.20	0.16	0.14
Practices open defecation	0.86	0.20	0.17	0.13	0.12
Bottom wealth quintile	0.21	0.15	0.14	0.12	0.10

Notes:
[a]MDES = Minimum detectable effect size (calculated in unites of standard deviation from the mean); Scenarios are taken from Table 4 above
[b]Power calculations were re-done for these outcomes as they are binary as opposed to continuous. The FA team therefore changed the power calculations from a comparison of means to a comparison of proportions. All other parameters remain the same. Units for the effect sizes are therefore percentage points.
[c]Means were taken from the 2015-16 DHS Angola for the Cuando Cubango province.

The FA team looks forward to discussions with USAID, TNC, and other IPs regarding whether these effect sizes are consistent with expectations for ECCO impacts. If MDES are much larger than could be realistically expected to achieve based on programming, the potential for useful learning than an IE is at greater risk, as smaller impacts would be indistinguishable from zero.

Design Options and Methods

Annex C provides an overview of different evaluation approaches—experimental, quasi-experimental, and non-experimental—that the FA team considered. Based on the information available, the FA team finds that ECCO is amenable to an evaluation design that includes mixed impact and performance evaluation elements. Some SAs—particularly SA1 and SA2 are more amenable to a causal impact analysis. However, ECCO is not amenable to a whole of project IE—nor are all SAs amenable to evaluation through IE methods. Activities that are not amenable to an IE can mostly be considered for a mixed-methods, rigorous PE. Table 7 provides a high-level summary of recommended evaluation approaches for each of the SAs. Notably, there are still gaps in the FA team's understanding regarding where specific activities are being planned and when. Annex D provides an overview of the current understanding. Gaining clarity on the potential planned locations and timing of activities is necessary before the evaluation design phase to ensure that an appropriate design for each SA is selected. Additionally, the GESI Action Plan will ensure that we are incorporating gender and social inclusion into the evaluation plan in a way that is suitable for the goals of ECCO.

Table 7: *Overview of Proposed Evaluation Approaches*

Strategic Approach	Sub Approach	Potential Evaluation Method(s)
SA1: Conservation livelihoods for biodiversity, forests, and climate resilience	Fishery cooperative structures and promoting long-term sustainability of fish populations	Impact; Mixed
	Sustainable conservation agriculture	Impact; Mixed
SA2: WASH and water resource management	Community-led total sanitation	Impact; Mixed
	Boreholes	Impact; Mixed
S3: Cross-sector landscape collaboration for biodiversity and human well-being	Private sector engagement on sustainable energy delivery	Performance; Case Study
	Knowledge management	Case Study

Strategic Approach 1: Evaluation Recommendation

For SA1, the FA team proposes three options as delineated below, and as summarized in Table 8.

SA1 Evaluation Option 1: DiD with matching for fisheries and conservation agriculture/forestry components

The first design entails a quasi-experimental DiD approach, with matching during analysis to improve rigor. Since not all treatment communities have been identified at this point, multiple baselines may be needed. The FA team would use basic demographic and geographic variables provided by municipal governments to match treatment villages to control villages to reduce initial observable differences. The DiD approach would then subtract the before-and-after change in outcomes of the non-treated community participants from the before-and-after change in outcomes of the treated community participants to find the relative change in outcomes for program participants. Additionally, regression analysis would control for observables that were discovered to be imbalanced at baseline. The rigor of an IE design would allow for important learning opportunities, particularly in inland fisheries literature which has a dearth of quality impact evaluations. Additionally, causal attribution of conservation agriculture to soil quality and both fishery and sustainable agriculture cooperatives to women empowerment represent important new areas of research.

The main concern with this approach is the proposed sample size. As discussed in the prior section, the total number of communities in a cluster-randomized intervention greatly impacts the minimum detectable effect size. At the current moment, the FA team is unclear about the total number of communities that will be targeted under SA1. It is also unclear if the different IPs (ACADIR and ADPP) will undertake similar activities that can be assessed in the same evaluation. The FA team requests additional clarity on the estimated total number of communities under ECCO as well as a clear delineation of activities by IPs to make a reasonable recommendation regarding the evaluation design of this component. At this point, based on recent conversations with TNC, it seems unlikely that there will be sufficient villages targeted to have sufficient power for an IE approach, though we still discuss this as an option below as we have not received confirmation on the number of villages.

Table 8: *Summary of Proposed Evaluation Design Options for SA1*

Proposed Evaluation Design	Summary of Methods Used	Main Benefits	Concerns
IE for both the fishing and CA components of SA1	DiD approach with matching and rolling enrollment	Rigorous design allows for causal attribution in new learning areas	Sample size large enough to detect changes in outcomes, particularly for fishing components
IE for the CA component and PE for the fishing components	DiD approach with matching and rolling enrollment in all communities PE approach to consider trends in fishing behavior and	Rigorous design allows for causal attribution in new learning areas for CA Given that the fishing components will be carried out in fewer	Missing causal attribution for key learning questions in fishing components

Proposed Evaluation Design	Summary of Methods Used	Main Benefits	Concerns
	qualitative data about fishery cooperative experiences	communities, PE coupled with qualitative data may be more suited to evaluating effects of those activities	Sample size large enough to detect changes in outcomes
PE for both the fishing and CA components of SA1	PE approach coupled with qualitative data collection from key stakeholders	Sample size is not a concern; PE will establish CA and fishing trends	Does not allow for causal attribution in new learning areas

SA1 Evaluation Option 2: DiD with matching for conservation agriculture component and PE for fishing components

Our understanding is that conservation agriculture and forestry components will be targeted in more villages than the fishery components. Therefore, if power is a concern for the evaluation of this SA, it is likely more of a concern for the fishery components. Therefore, this option proposes to use the same DiD with matching approach as outlined in Option 1 for the conservation agriculture activities, while using a PE approach coupled with qualitative data from key stakeholders to examine trends and evaluate effects of the fishing activities.

SA1 Evaluation Option 3: PE for all components

If the targeted number of communities under SA1 is not sufficient to reasonably detect effects with an IE design, then the FA team would recommend a PE approach for all components. The PE approach would allow for an understanding of trends in treatment communities and qualitative interviews with cooperative members would allow for an understanding of how cooperative participation affected conservation behaviors, empowerment, and livelihoods. However, this approach would not allow for causal attribution of the activities under SA1. Given the novel learning opportunities, particularly around inland fisheries, soil quality and conservation agriculture, and gender empowerment through cooperative participation, the FA team would only recommend this option if sample size was a major concern.

A clearer recommendation between options will be possible once the FA team receives clarity about the Year 1 targeted SA1 communities as well as an estimate of total communities planned to be targeted under SA1. While the FA team acknowledges that the full set of communities for SA1 is not yet known, we would expect that ACADIR and TNC to have a rough sense of the total number of communities that could be potentially targeted under ECCO. As soon as the FA team has this estimated number of total SA1 communities, we will be able to revisit our power calculations to determine which evaluation option is recommended for SA1.

STRATEGIC APPROACH 2: EVALUATION RECOMMENDATION

For SA2, the FA team strongly recommends using DiD methodology with matching. Unlike SA1, the communities that DW plans to include in WASH programming have been pre-selected which allows for *ex ante* matching and a single baseline. The FA team recommends this methodology because of the novel learning opportunities available. The proposed outcomes include items that would contribute substantially to the understanding of WASH interventions on human wellbeing and surface water quality. Surface water quality testing is itself a novel outcome, as is stool sampling as a measure of enteric infection in an IE. Given the ambitious latrine coverage target (95 percent), the FA team believes that even with a smaller cluster sample size, the IE will be able to pick up important outcomes that have been difficult to capture in the literature to-date. Further, this evaluation would be the first to use the proposed simplified time savings module in a WASH evaluation, providing an important learning opportunity about a new method to capture time savings in WASH evaluations. Finally, the WTP study by gender will answer important questions about differential preferences for sanitation across genders.

Currently, DW is planning to target twenty communities within Menongue and Cuchi municipalities to receive the WASH interventions. The concern with so few targeted intervention communities is having sufficient power to detect effect sizes as illustrated in the prior section. However, certain activities have such obvious and strong causal links to intended outcomes, that with good implementation, detectable effects should still be observed.[64] For example, repairing broken boreholes in the community should have a very large effect on the number of households with access to improved water sources. For outcomes that may not be detectable due to sample size, the FA team recommends a complementary PE approach that assesses trends in behaviors as well as qualitative data collection among key stakeholders about sanitation behaviors and knowledge in the communities.

It is important to note that the number of treatment communities in this IE may be bolstered by including ADPP implementation sites (n=15) in Cuito Cuanavale and Longa. ADPP is also conducting WASH programming, but it is unclear what activities are planned in which communities. In-country meetings revealed that ADPP's approach was to allow target communities to choose which sector (WASH, fishery, agriculture, or forest) ADPP would engage in and that the primary activities would be providing educational and informational materials. This approach does not lend itself well to IE methodologies. However, meetings with TNC and the Year 1 workplan indicated more extensive involvement of ADPP in WASH activities, though it was still unclear which communities were being targeted for such activities. The FA team requests clarity on ADPP's involvement in WASH programming and overall approach in order to assess whether those implementation sites would be reasonable to include in the SA2 evaluation. Including ADPP implementation sites would increase total treatment communities to 35 and total clusters to 70.

Beyond sample size, the other concern is the timing of rollout. The FA team's understanding is that DW is planning to target six communities per year starting in October 2023. Given that timing, the baseline survey in those first six communities may not be an adequate representation of pre-intervention levels of sanitation knowledge and behaviors, as the baseline survey would be conducted after implementation

[64] The FA team acknowledges that this may not be true across all potential outcomes. Self-reported diarrhea as mentioned in the section on power calculations is of particular concern, which is partly why the FA team strongly recommends stool sampling as a measure of enteric infection.

had begun. For this component, the FA team requests more-detailed updates of the timing of intervention rollout and suggests that baseline data collection be conducted as soon as possible.

Strategic Approach 3: Evaluation Recommendation

SA3, at least in part, will support SA1 and SA2. Developing new educational materials and knowledge sharing will inform the interventions and information given to beneficiaries in SA1 and SA2. Therefore, the proposed evaluations of SA1 and SA2 will implicitly evaluate outputs from SA3 as well. Additionally, the FA team proposes a PE approach of private sector engagement on rollout of clean cookstoves and promotion of sustainable energy.[65] This activity and its target communities is still under development. A PE approach would allow for examination of how the private sector engaged with IPs in rollout of clean cookstoves. Additionally, for the knowledge sharing component of SA3, a case study analysis of how IPs collaborated and shared knowledge throughout ECCO would provide useful guidance for how to engage multiple partners in the implementation of conservation-based projects.

Impact Evaluation Methodology

For both SA1 and SA2, the FA team is recommending a DiD, which is a quasi-experimental evaluation design that estimates programmatic impact by comparing (1) changes in outcomes among program participants with (2) changes in outcomes among non-participants. This method requires four data points: participant group baseline, participant group endline, non-participant group baseline, and non-participant group endline. Comparing changes over time between participant and non-participant groups helps control for unobserved and observed fixed confounding factors. The comparison group serves as a counterfactual for the treatment group, providing estimates on what would have happened to the treatment group, had they not received the program intervention.

DiD is one of the most frequently used methods for IEs. In the context of ECCO, a DiD method can be used to compare outcomes over time for human health, well-being, conservation knowledge and behaviors, and livelihood factors between villages involved in ECCO and villages not involved in ECCO but located in the same municipalities. Given the inability to randomize implementation across these sites, a randomized control trial (RCT) or experimental design is not feasible for an evaluation of these components and DiD approaches provide a rigorous alternative.

DiD is a data-driven method which requires a large-scale data collection effort and econometric methods to minimize selection bias between treatment (ECCO) and comparison (counterfactual) groups. However, DiD requires stronger assumptions than randomized selection, and there are several methodological limitations. The key identifying assumption for DiD is the parallel or common trends assumption, which states that the counterfactual trend behavior will be the same in treatment and control areas. This strong assumption represents the key limitation of DiD—it cannot control for time-dependent differences between treatment and control groups. For example, if another organization initiated a WASH project in a control ECCO district, the DiD would not be able to control for these

[65] Note that the FA team is unclear about whether private sector engagement with clean energy is being included as part of SA2 (as it is in the Year 2 workplan) or in SA3 (as it was described to us in country and in parts of the MERL plan). Regardless of classification as SA2 or SA3, the recommended evaluation design remains the same.

events as part of the regression analysis. For DiD to produce a valid counterfactual, the FA team must assume that no time varying differences between the treatment and control groups.

Thus, the DiD strategy is valid if ECCO is the only factor that induces a deviation from common trends for well-being, livelihoods, conservation knowledge and behaviors, and biophysical changes—including other factors of interest to the evaluation. Although the treatment and control areas can, and often do, differ before implementation, this difference must not be reflected in different time trends for key indicators.

The FA team can also mitigate weaknesses in the DiD design with an estimation strategy that combines matching with DiD to improve comparability between groups. There is lack of pre-treatment data in the municipalities of interest, so the FA team recommends that matching techniques be conducted at the analysis stage to improve the balance[66] between treatment and control areas. The FA team would recommend using municipality provided data at the village level[67] to first select similar control areas based on key variables such as population size of the village, distance to a major road, existence of a school, distance to the municipality headquarters, and existence of a health center. Annex E contains a list of this data for the provided intervention communities. Given that this list of key variables is non-exhaustive, the FA team recommends that propensity score matching be applied with baseline data to generate inverse probability weights that can be used within the DiD methodology to ensure a more balanced baseline sample. The final selection of comparison areas for a DiD design would occur during the evaluation design process in collaboration with TNC and IPs.

[66] Balance is defined as whether characteristics are similar between treatment and control groups. Balance tests often include means-comparisons for key covariates and outcomes between such groups.

[67] Note that currently the FA team only has this data for targeted treatment communities but has requested the full set of villages within each target municipality from TNC and IPs.

Challenges and Limitations

There are several challenges to conducting an impact evaluation of ECCO. However, many of these challenges are not unique to ECCO. Instead, design challenges such as phased implementation and related data collection challenges, multiple, bundled interventions, long-time horizons necessary to observe changes in key outcomes, selection bias of communities, and historical legacy of prior interventions are common across impact evaluations for development projects in many sectors. The main challenges to the rigor and integrity of the evaluation include (1) having limited statistical power to detect effects (such as, from small sample sizes, large variances/heterogeneity in outcomes, etc.), (2) identification of valid comparison areas, (3) timing and phasing of implementation rollout (i.e., beginning certain activities prior to baseline evaluation data being collected, uncertainty about locations for certain activities, and phased implementation rollout), (4) potential spillovers particularly in the fishing activities, (5) measurements of long-term impacts, and (6) issues related to non-compliance. Each of these challenges is discussed below.

Design Challenges and Threats to Integrity

Limited statistical power. As discussed throughout this report, the limited number of targeted clusters challenge the ability to detect statistically significant effects. For SA1, if fewer than 20 villages are being targeted for fishing activities, the FA team would recommend pursuing a PE rather than an IE approach. For SA2, including ADPP villages in the WASH evaluation would substantially alleviate sample size concerns (increasing treatment communities from 20 to 35 and total evaluation communities from 40 to 70).[68] With only the 20 DW treatment communities, the FA team would have concerns about having a large enough sample to detect health and overall well-being outcomes. However, given the activity targets, the FA team believes that an IE evaluation would still be able to detect changes in water and sanitation behaviors, time savings, and measures of improved water security.

Identification of valid comparison areas. Without pre-treatment data, it is difficult to extensively minimize differences between treatment and control communities. Nonetheless, the FA team recommends using a strategy of matching during the analysis stage to mitigate the effects of such differences. Furthermore, the FA team recommends including questions in the endline surveys about activities from other governmental and non-governmental organizations doing similar conservation, agriculture, and health interventions to assess the degree of potential contamination.

Timing and phasing of implementation rollout. The timing of the implementation rollout and uncertainty about the locations for certain activities has significant implications for the evaluation design. The Year 1 workplan indicates that most activities will begin during October 2023 and March 2024. However, it is unclear how many of the targeted communities will be targeted during that time. Table 6 of the Year 1 workplan presents the summary for ECCO Fiscal Year 24 activities. While the location column sometimes lists specific village and community names, typically only municipality names are

[68] The decision about whether to include ADPP villages in the proposed WASH evaluation will require a more clearly delineated description of sub-activities to assess the comparability to DW WASH activities.

included. It is, therefore, unclear whether all targeted villages in the municipalities will receive the sub activity at that time or whether a subset. The FA team requests clarification about which villages/communities at the sub-municipality level are being extensively targeted in Year 1 Fiscal Year 24 activities. The extent that project implementation begins before the baseline evaluation survey can be conducted affects the validity of baseline measures and may reduce total cluster size. For example, if five communities have received substantial components of the intervention before the baseline evaluation survey is conducted, those communities may need to be dropped from the IE.

Additionally, the uncertainty about the locations particularly for SA1 locations has significant implications for the evaluation design. As stated previously, the FA team is unable to make a recommendation about an IE or PE approach until there is a better understanding of the number of desired or targeted treatment communities (even if those treatment communities have not all been selected at this point). Given that not all communities have been selected for SA1, the FA team recommends collecting baseline data in a phased approach at the beginning of each project year until enrollment into the project is complete. While more costly, since communities will continuously be enrolled into SA1 throughout the five-year project period, doing a one-time baseline would have to happen at a time in which substantive activities would have already taken place in many of the communities. The FA team will need TNC and IP agreement to not enroll selected control communities as future intervention communities. The FA team further recommends revisiting this approach at the end of Year 1 when enrollment plans for future communities may be clearer.

For SA2, the full set of communities is known, but phased implementation is planned (DW is roughly targeting six communities per year). Thus, for SA2, there are two options for baseline data collection: (1) collect baseline data in a phased approach similar to SA1, or (2) once as soon as possible. Given the additional cost of phased data but limited additional technical value, the FA team's recommendation is to conduct one comprehensive baseline for SA2.

Potential spillovers. To the extent that ECCO activities have broader ecosystem effects, these effects may also be experienced in selected control communities, and thus will be more difficult to detect and attribute to the project. For example, if more sustainable fishing practices through SA1 results in larger and more fish in nearby lagoons, catch assessment surveys in control villages might also show larger fish and larger catch sizes. Thus, in an IE framework that compares changes over time between treatment and control communities, it would be difficult to attribute effects to the ECCO activities. With a larger sample size, one could intentionally select sets of controls both inside and outside of the same ecosystem (e.g., within a separate river system) for comparison to intentionally measure such spillovers. While theoretically possible, other river systems in Angola are located far away from the targeted communities (e.g., Cuanza river) and thus would not serve as valid comparison groups for the livelihoods and wellbeing portions of the evaluation. Instead, the evaluation can mitigate spillover risk by establishing treatment and control communities. Another option would be to use IE for the livelihoods, behaviors, and wellbeing portion of the SA1 evaluation while relying on PE methods to assess trends over time from the eCAS data collection. The FA team recommends having a fuller discussion with TNC and IPs about the potential for spillovers during the evaluation design stage to inform the best approach.

Measurement of long-term impacts. Certain biophysical outcomes of interest, such as improved soil quality from adoption of conservation agriculture, may take a longer time period to materialize than

the standard USAID Program Cycle. In addition, long-term data on well-being, livelihoods, gender norms, and health will answer important questions about the sustainability of the program.[69] To capture longer-term effects that are key to USAID's learning agenda, the FA team proposes a follow-up to endline data collection about five years after the end of the project. The evaluation can also provide value by measuring shorter-term outcomes at midline (halfway through the program implementation, at about Year 3) and endline (at the end of program implementation, at the end of Year 5), which can provide early evidence regarding the potential sustainability of impacts. For example, if there is no evidence that people are changing behavior at endline, it is unlikely long-term impacts would be achieved. Overall, this 10-year time period—which has long been used for health and education programming and increasingly for land and resource tenure and democracy and governance programming—will provide important value for USAID.

Non-compliance or partial compliance occurs when there is a deviation from implementation plans (i.e., people in control areas receive activities, or people in treatment areas do not receive activities). This can happen for a variety of reasons—for example, perhaps someone who signs up for a farmer training never attends, or instead of using new fishing materials, decides to sell them instead (both examples of treatment not getting treated). Or perhaps IPs do not adhere to implementation plans and implement activities in control areas (an example of controls getting treated). To minimize the potential threats from non-compliance, the FA team will need to ensure strong buy-in from all IPs, as well as ensure there are robust tracking systems in place regarding who is receiving what activities throughout the program.

Other Challenges

In addition to the challenges and limitations discussed above, a clear delineation of responsibility for evaluation tasks will need to be established between TNC and the FA team. The MERL plan submitted by TNC had several evaluation components that would overlap with the proposed evaluation options presented in this FA. The FA team recommends that upon finalizing the evaluation design, USAID facilitates a discussion of evaluation priorities and tasks between TNC and the FA team. In the absence of such a delineation, there is the risk of duplicating efforts and exacerbating respondent fatigue. For example, TNC is currently conducting their own extensive baseline survey. Since the FA team's evaluation design had not yet been finalized, there was a missed opportunity to join efforts to design and deploy one single baseline survey. To avoid future potential overlaps in effort, an agreement about evaluation roles and responsibilities will need to be reached at the evaluation design stage.

Additional Information Needs for Evaluation Design

If USAID decides to move forward with an evaluation of the ECCO Activity, it will be important for the evaluation team to continue discussions with USAID, TNC, and other IPs during planning and

[69] Recent research in the WASH literature, has found, unsustained latrine use in the long-term and reversion to open defecation even in areas where latrine adoption was initially high; see: Orgill-Meyer, J., Subhrendu Pattanayak, Namrata Chindarkar, Katherine Dickinson, Upendra Panda, Barendra Sahoo, Ashok Singha, and Marc Jeuland, "Long-term impact of a community-led total sanitation campaign in India, 2005-2016," *Bulletin of the World Health Organization,* Vol. 97, Issue 8 (2019): 523-533A.

implementation. Additional details on specific implementation plans and work planning for the activity will enable the team to further develop and refine an evaluation design. Some outstanding points to clarify are below:

- Final intervention plans:
    - For SA1, what are the total number of villages and locations by each IP (ACADIR, TNC, ADPP)?
    - Which activities under SA1 will be similar across IPs? For example, ACADIR and TNC are implementing cooperatives while ADPP is not. Are all IPs providing similar information and education on best fishing practices? Are there differences in the approach taken to promote conservation agriculture? For an IE the evaluation would need to rely on villages from all IPs, so understanding the degree of overlap in *which specific interventions* is necessary for the evaluation team to know.
    - For SA2, what is the degree of similarity between the ADPP and DW approaches? Does it make sense to include ADPP villages in this intervention? Will there be similar borehole training and community-led total sanitation?
    - For SA2, how many of the intervention villages are located along a river?
    - For all SAs, what is the proposed rollout by village?
- **Municipality provided village data:** To conduct coarse matching for control village selection, we will rely on municipality data for each village with items such as number of households, number of health centers, number of schools, etc. We have not yet received these data.
- **Further details on extent and content of IP biodiversity monitoring:** We understand that ACADIR and TNC will implement eCAS systems in seven of the villages receiving fishery interventions. Will this system also be used by ADPP for monitoring? Is this system replicable in comparison areas? Are there any other forms of biodiversity monitoring planned by the IPs beyond eCAS?

Illustrative Costings

Table 9 provides illustrative cost estimates to finalize the evaluation design, conduct data collection, and analyze and report on findings for 1) a stand-alone evaluation of SA1's fisheries component; 2) a stand-alone evaluation of SA2's WASH component; 3) the SA1 fisheries and SA2 WASH evaluation combined; and 4) an add-on assessment on SA1's agriculture component (when added to any prior option). We present 'high' and 'low' estimates for each, with a range of sample sizes therein. Data collection activities include household surveys, catch assessments, stool and water sampling and testing, and soil sampling as described in prior sections of this FA. For all evaluations, it is also possible to add mid-line or long-term end-line data collection activities, at approximately 90 percent of the cost of the base-line round.

Table 9: *Illustrative Cost Estimates*

	High Estimate				Low Estimate			
Budget Estimate by Design Option	**SA1 Fisheries Stand-alone**	**SA2 WASH Stand-alone**	**SA1 Fisheries and SA2 WASH Combined**	**SA1 Agriculture Add-on**	**SA1 Fisheries Stand-alone**	**SA2 WASH Stand-alone**	**SA1 Fisheries and SA2 WASH Combined**	**SA1 Agriculture Add-on**
Data Collection Rounds	Baseline, Endline	Baseline, Endline	Baseline, Endline	Baseline, Endline	Baseline, Endline	Baseline, Endline	Baseline, Endline	Baseline, Endline
Household Surveys per round	2400	1800	4200	2400	1200	1200	2400	1200
Catch Assessments per round	80	0	80	0	40	0	40	0
Stool and Water Samples per round	0	1500 *(comprehensive pathogen panel)*	1500 *(comprehensive pathogen panel)*	0	0	1000 *(limited pathogen panel)*	1000 *(limited pathogen panel)*	0
Soil Samples per round	0	0	0	80	0	0	0	40
Baseline - Labor, Consultant, Travel, ODCs, G&A	$352,852	$289,801	$525,117	$127,999	$297,637	$240,404	$422,688	$110,685
Baseline - Data Collection	$180,000	$324,000	$504,000	$96,000	$90,000	$156,000	$246,000	$48,000
Endline - Labor, Consultant, Travel, ODCs, G&A	$420,050	$345,873	$632,630	$190,587	$358,250	$293,501	$511,779	$113,101

Endline - Data Collection	$202,592	$364,665	$567,256	$99,012	$101,296	$175,579	$276,875	$49,506
Estimated Baseline Cost	$532,852	$613,801	$1,029,117	$223,999	$387,637	$396,404	$668,688	$158,685
Estimated Endline Cost	$622,642	$710,537	$1,199,886	$289,599	$459,546	$469,080	$788,654	$162,607
Estimated Total Cost	$1,155,494	$1,324,338	$2,229,003	$513,598	$847,183	$865,485	$1,457,342	$321,293

Alignment with the USAID Program Cycle

USAID's Program Cycle, codified in the Automated Directive Systems (ADS) 201, is the Agency's, "operational model for planning, delivering, assessing, and adapting development programming in a given region or country to achieve more effective and sustainable results."[70] According to the ADS 201, the value of an evaluation is in its use, including to inform Agency decision-making, contribute to learning, and help improve the quality of development programs.[71] There are several ways in which findings from an evaluation of the ECCO Activity can be used for adaptive programming and to inform future programming decisions:

- Baseline findings would be an important information source for overall monitoring & evaluation of the activity. While eCAS is being used to capture data in most fishery villages, none of the other proposed biophysical outcomes are currently being monitored, to our knowledge. Further, the detail proposed in the baseline household surveys would provide additional contextual information to help inform adaptive programming, as well as assess support for some of the key underlying assumptions of the ToC.
- Supplemental analysis tracking of the eCAS data would help support USAID's adaptive management. Tracking trends in fish populations could provide preliminary indicators of whether improvements are being made for these outcomes. Midline data collection, focusing on intermediate or short-term outcomes important for the ToC, will also be useful for adaptive management.
- The endline analysis at the completion of the activity would provide a comprehensive analysis of performance and impact indicators, as well as an analysis of implementation issues. Depending on the timing of USAID/Southern Africa's Program Cycle, this could either inform decision making related to continuing funding for the ECCO Activity, other integrated being implemented by USAID/Southern Africa, or other activities in the HEARTH portfolio more broadly.
- Finally, the long-term follow-up evaluating impact and sustainability post-activity completion would provide important learning for other activities in the HEARTH portfolio, USAID, and the development community at large. Assessing long-term impacts would provide more accurate inputs for estimates of value for money, which would help inform current and future programming and investments more broadly for USAID.

[70] USAID Learning Lab. "The USAID Program Cycle," https://usaidlearninglab.org/program-cycle-overview-page

[71] USAID Bureau for Policy, Planning, and Learning (PPL). "ADS Chapter 201: Program Cycle Operational Policy." Revised 21 September 2021. https://www.usaid.gov/sites/default/files/documents/201.pdf

Ultimately, use of the findings will require coordination with the USAID/Southern Africa Mission and IPs as well as awareness of their programming needs. We recommend following principles of utilization-focused evaluation to help USAID and the IPs best make use of results and data.[72] This will include determining what kinds of reporting formats, styles, and venues are most appropriate, making sure results are delivered in time to affect important decisions, and deciding if findings merit wider dissemination.[73]Additionally, given that we are aware at the outset that some of the biophysical outcomes will likely take a longer time scale to be realized than the typical 5-year Program Cycle (i.e., observable reduced land clearing from conservation agriculture or changes to fish ecosystems), we would recommend that USAID/Southern Africa take this into consideration when making programming decisions.

[72] Patton, Michael Quinn, *Essentials of utilization-focused evaluation,* Sage, 2012.

[73] Patton, Michael Quinn, "Utilization-Focused Evaluation (U-FE) Checklist," *The Evaluation Center,* 2013, https://wmich.edu/sites/default/files/attachements/u350/2014/UFE_checklist_2013.pdf

Summary and Recommendations

Viability of an evaluation: This report seeks to determine the feasibility of a rigorous evaluation for the ECCO Activity. Our analysis finds that some ECCO Activity interventions are amenable to an IE, while other interventions are amenable to a rigorous PE. The ECCO Activity overall is not amenable to a whole of project IE, and final decisions about the evaluation design for many of the activities, particularly relating to SA1, will need to be made when the interventions and sites are more fully fleshed out, which may necessitate another scoping trip by the evaluation team.

The FA team finds that the ECCO Activity presents an important opportunity to improve USAID's baseline understanding of conservation and biodiversity programming through mixed methods evaluation. For the fishery and conservation agriculture components of SA1, the FA team recommends an IE approach if there will be at least 20 targeted intervention villages. TNC is still in the process of working with the IPs to determine interventions and sites for this SA, but in the case that there will be fewer than 20 intervention villages receiving similar activities, the FA team recommends a rigorous PE. Given the dearth of counterfactual studies on inland-fishery interventions and on the outcomes proposed for the conservation agriculture intervention, even knowledge generated through a well-designed PE would advance USAID's and the HEARTH portfolio's learning agenda. For the borehole repair and community-led total sanitation activities under SA2, the FA team recommends an IE approach, using coarse matching and DiD. The outcomes proposed for this evaluation provide novel learning opportunities with both the WASH and biodiversity literatures. Using stool sampling, innovative time use measures, and gender-based WTP studies all provide significant contributions to the WASH literature. Linking the WASH activities to river and fish health will generate significant learning about the overlap between human and biodiversity well-being in this landscape. Finally, for SA3, the FA team recommends a combination of case-studies and PE approaches that can generate knowledge about coordination and knowledge-sharing between private sector parties in these domains.

Evaluations of these activities would add value by strengthening the program's ToC and promoting a deeper understanding of where to focus on intervention integration and quality. Baseline data will provide a key source of M&E data and provide important contextual information that can be used to promote more effective, adaptive programming.

Timing of baseline data collection: Given the uncertainty about interventions and locations particularly for SA1, the FA team recommends waiting until late Spring / early Summer 2024 to conduct one comprehensive baseline household data collection effort. Ideally, a scoping trip would precede baseline data collection for the evaluation team to try to gather more information about planned interventions and locations as well as to try to work with municipal governments to obtain data for matching to select control villages. Given that some programming has already begun, there is not the opportunity to have a 'true' baseline particularly for the human well-being outcomes. While this is a limitation, the FA team does not expect significant changes in important human well-being outcomes prior to this single baseline.

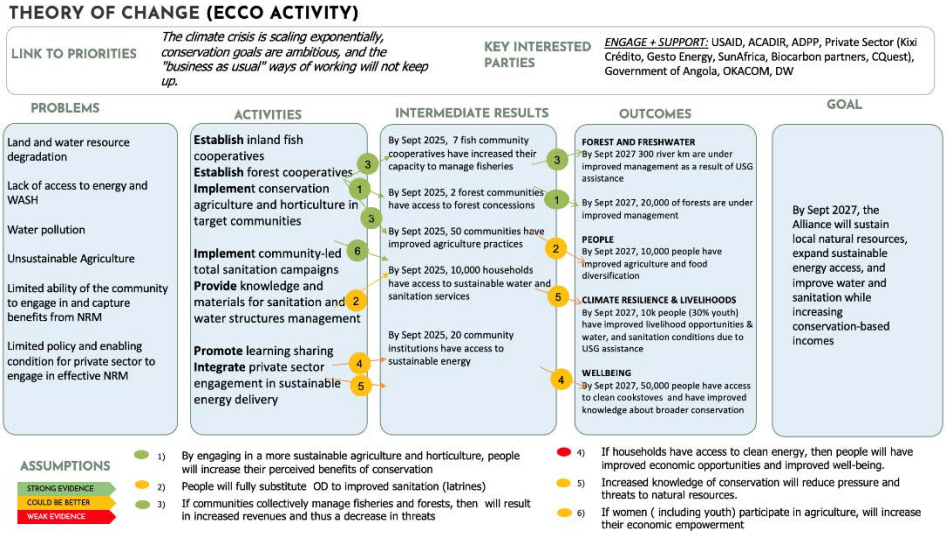
Need for Pause and Reflect: As mentioned throughout this report, the site locations and content for most of the interventions (particularly SA1) will not be finalized until the end of Year 1, as the IPs complete their situation analyses and needs assessments. The FA team recommends a series of regular coordination and information exchanges as implementation information becomes available. In addition, at the end of year 1, the MERL plan will need to be updated and there should be a Pause and Reflect of all stakeholders. It will also be important for the evaluation team to revisit the logic model and ToC to ensure consistency with the implementation plans as they are finalized.

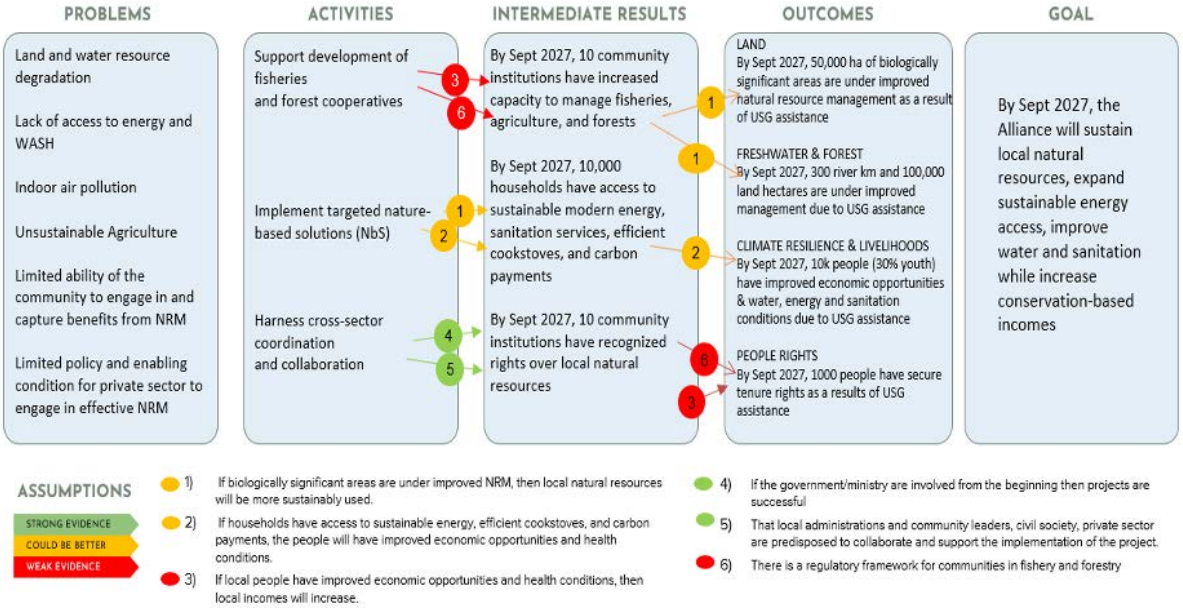
Need for local academic collaborators: The FA team recommends building partnerships with local academic collaborators as soon as possible. In addition, the FA team recommends that any human subjects research go through local IRB processes. Both of these—local collaborators and local IRBs—are norms for publishing research in most peer-reviewed journals now. In additional, local collaborators could help to provide important contextual knowledge, lab space, and other expertise as needed.

Biodiversity measures: To ensure a cost-effective study, the FA team recommends utilizing the eCAS system utilized as part of the IP monitoring in the villages receiving the fishery activities. We strongly recommend that for monitoring consistency, the same system is used by all IPs. Given the data poor environment in Angola, the remaining biophysical and biodiversity measures (soil quality, water quality, etc.) will need to be collected as part of the evaluation. Many of the important outcomes from the ToC such as reduced planned forest clearing due to conservation agriculture activities can also be captured through household surveys.

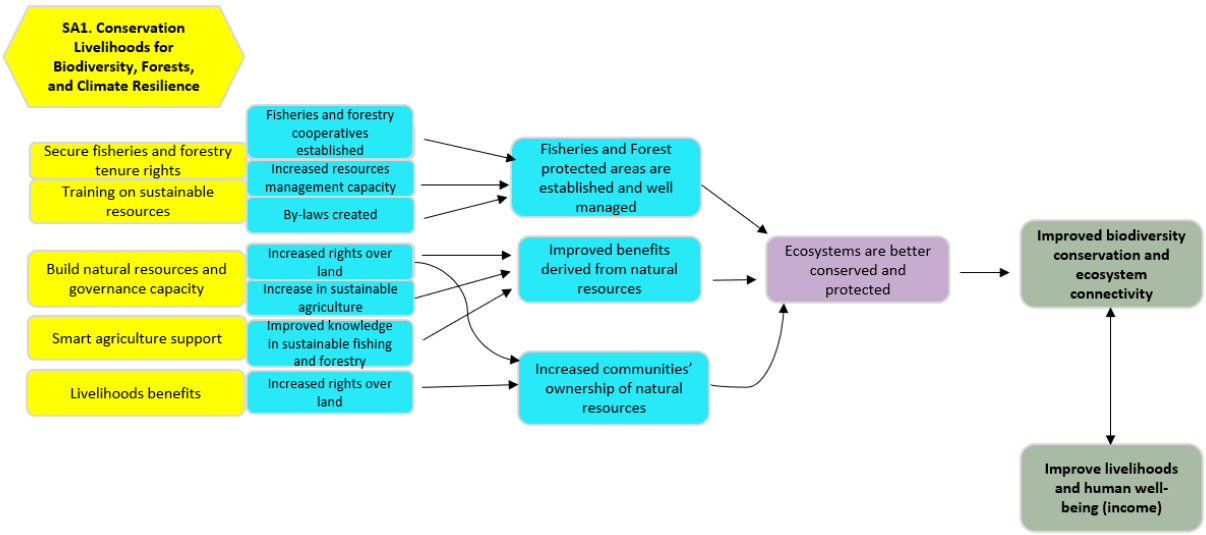
Strong coordination and collaboration are required throughout design and implementation: A rigorous evaluation will require detailed M&E tracking of inputs, outputs, and specific site locations, along with significant coordination among the IPs and between the IPs and the evaluation team, to ensure that the design is appropriate as implementation plans evolve. Additionally, a clearer delineation between the objectives and responsibilities of the TNC MERL plan and the evaluation team will be needed to avoid duplicating efforts and exacerbating respondent fatigue.

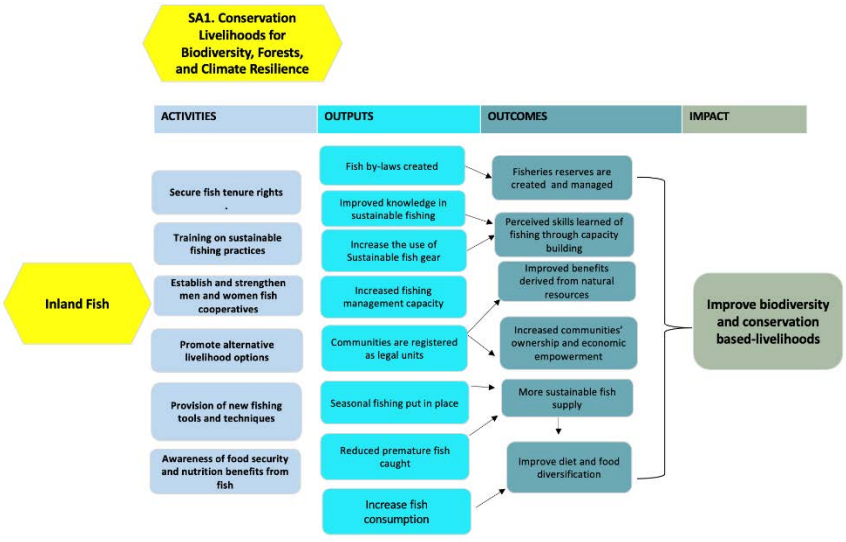
Annex A: Whole Project Draft Theory of Change

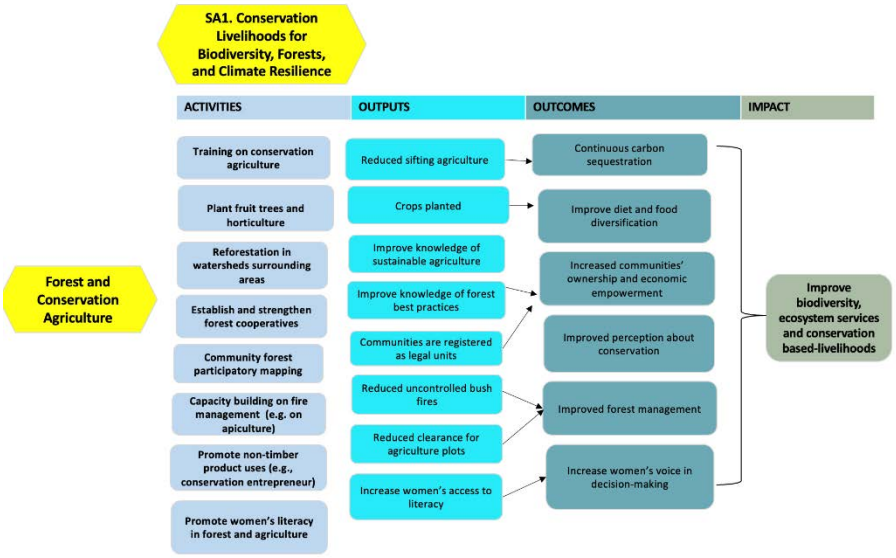


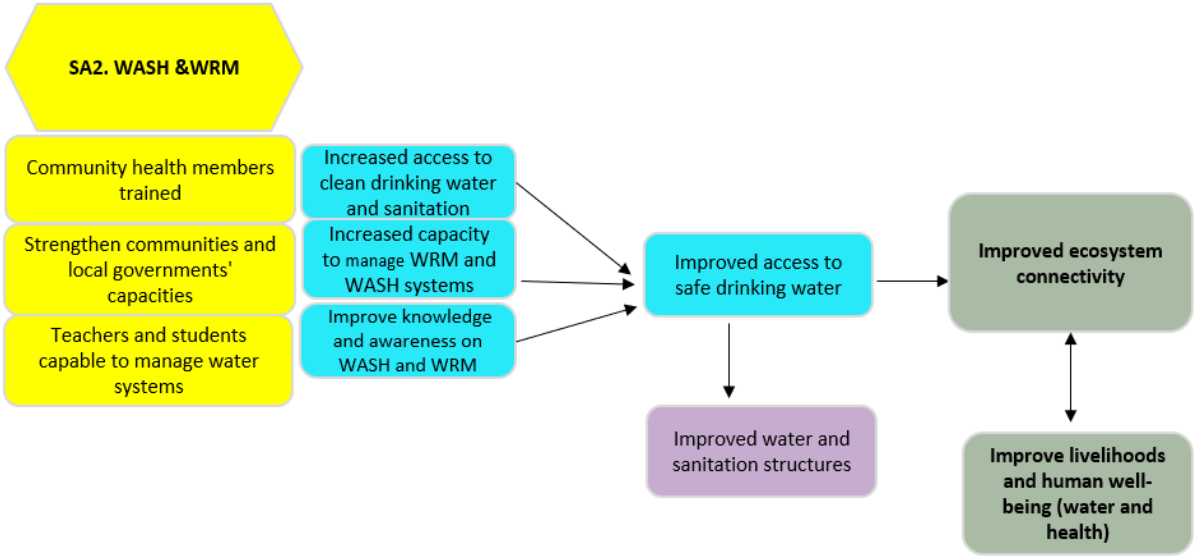


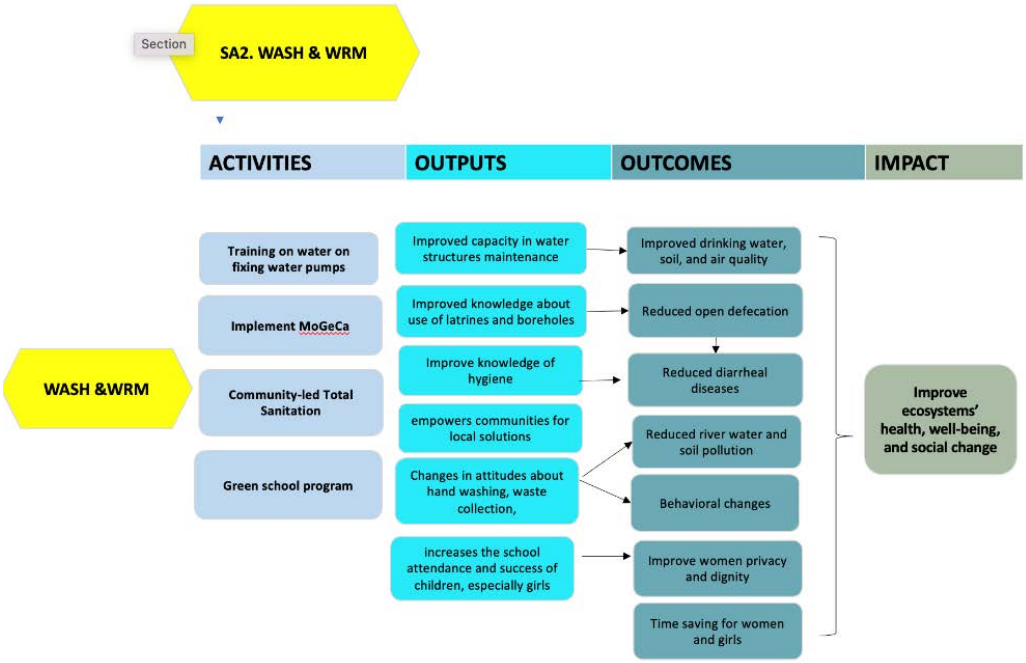
Annex B: TNC Draft Logic Models

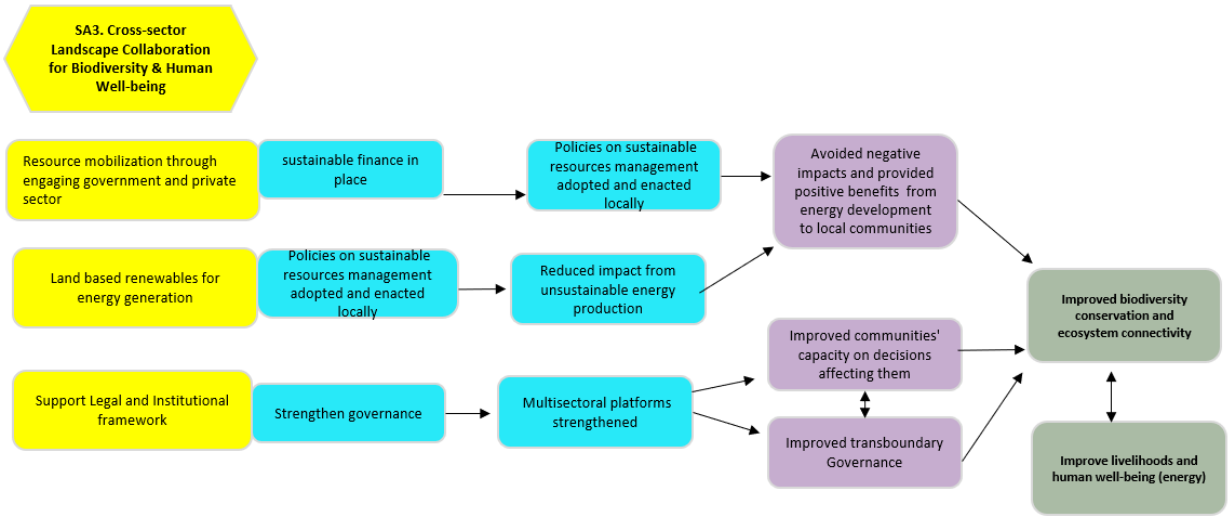


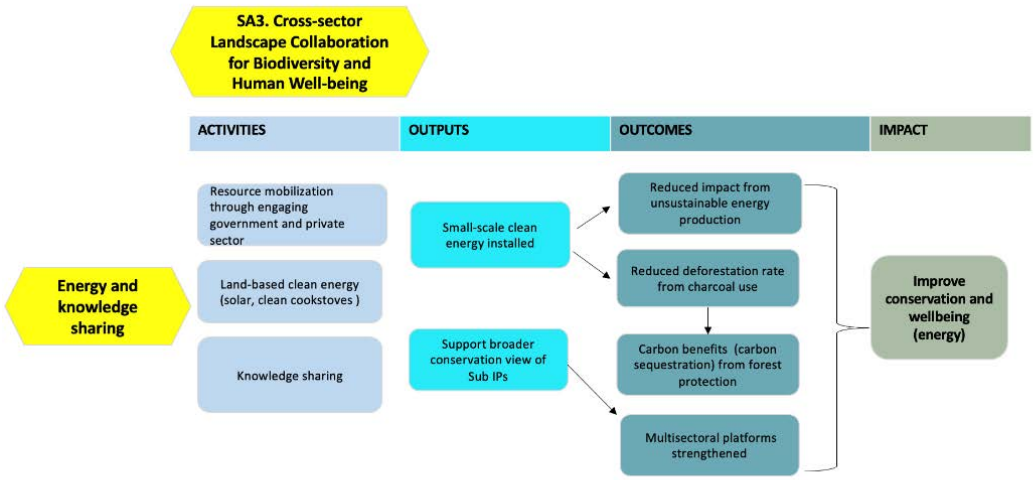



SA1. Conservation Livelihoods for Biodiversity, Forests, and Climate Resilience
ACTIVITIES
OUTPUTS
OUTCOMES
IMPACT
Forest and Conservation Agriculture
Training on conservation agriculture
Plant fruit trees and horticulture
Reforestation in watersheds surrounding areas
Establish and strengthen forest cooperatives
Community forest participatory mapping
Capacity building on fire management (e.g. on apiculture)
Promote non-timber product uses (e.g., conservation entrepreneur)
Promote women's literacy in forest and agriculture
Reduced sifting agriculture
Crops planted
Improve knowledge of sustainable agriculture
Improve knowledge of forest best practices
Communities are registered as legal units
Reduced uncontrolled bush fires
Reduced clearance for agriculture plots
Increase women's access to literacy
Continuous carbon sequestration
Improve diet and food diversification
Increased communities' ownership and economic empowerment
Improved perception about conservation
Improved forest management
Increase women's voice in decision-making
Improve biodiversity, ecosystem services and conservation based-livelihoods


SA2. WASH &WRM
Community health members trained
Strengthen communities and local governments' capacities
Teachers and students capable to manage water systems
Increased access to clean drinking water and sanitation
Increased capacity to manage WRM and WASH systems
Improve knowledge and awareness on WASH and WRM
Improved access to safe drinking water
Improved water and sanitation structures
Improved ecosystem connectivity
Improve livelihoods and human well-being (water and health)


Section
SA2. WASH & WRM
ACTIVITIES
OUTPUTS
OUTCOMES
IMPACT
WASH &WRM
Training on water on fixing water pumps
Implement MoGeCa
Community-led Total Sanitation
Green school program
Improved capacity in water structures maintenance
Improved knowledge about use of latrines and boreholes
Improve knowledge of hygiene
empowers communities for local solutions
Changes in attitudes about hand washing, waste collection,
increases the school attendance and success of children, especially girls
Improved drinking water, soil, and air quality
Reduced open defecation
Reduced diarrheal diseases
Reduced river water and soil pollution
Behavioral changes
Improve women privacy and dignity
Time saving for women and girls
Improve ecosystems' health, well-being, and social change


SA3. Cross-sector Landscape Collaboration for Biodiversity & Human Well-being
Resource mobilization through engaging government and private sector
sustainable finance in place
Policies on sustainable resources management adopted and enacted locally
Land based renewables for energy generation
Policies on sustainable resources management adopted and enacted locally
Reduced impact from unsustainable energy production
Support Legal and Institutional framework
Strengthen governance
Multisectoral platforms strengthened
Avoided negative impacts and provided positive benefits from energy development to local communities
Improved communities' capacity on decisions affecting them
Improved transboundary Governance
Improved biodiversity conservation and ecosystem connectivity
Improve livelihoods and human well-being (energy)


SA3. Cross-sector Landscape Collaboration for Biodiversity and Human Well-being
ACTIVITIES
OUTPUTS
OUTCOMES
IMPACT
Energy and knowledge sharing
Resource mobilization through engaging government and private sector
Land-based clean energy (solar, clean cookstoves)
Knowledge sharing
Small-scale clean energy installed
Support broader conservation view of Sub IPs
Reduced impact from unsustainable energy production
Reduced deforestation rate from charcoal use
Carbon benefits (carbon sequestration) from forest protection
Multisectoral platforms strengthened
Improve conservation and wellbeing (energy)

Annex C: Methods Considered to Measure Fishery Biophysical Outcomes

For outcomes related to biophysical and biodiversity changes in inland capture fisheries, the FA team considered three general categories of monitoring approaches. The first, participatory monitoring or Fisheries Dependent Survey, uses forms of self-reporting. Traditionally, logbooks were used to capture numbers, breeds, and sizes of fish caught. This form of monitoring is low-cost but subject to biases and measurement error on the part of the fishers.[74] TNC and ACADIR have recently rolled out an eCAS in villages with local Fishing Cooperative members to collect similar catch information, in an effort to reduce such measurement error.[75] These tablet-based monitoring systems also allow data to be evaluated remotely and on an ongoing basis. This is the method that the FA team ultimately recommended given that it will already be in use by treatment villages and given the likelihood of observing detectable changes with the other two methods discussed below.

Second, independent fisheries monitoring or Fisheries Independent Survey, uses a range of standardized research fishing gear to obtain a representative sample of the ichthyofaunal community present. Using standardized gears and processes ensures a wider spectrum of the species is sampled. However, they are often more costly, high-tech and require higher skill levels.[76] These surveys are generally considered more comparable between years. The Namibian Ministry of Fisheries and Marine Resources has been conducting fish and fisheries monitoring along the length of the Kavango River, within the Okavango basin, since 1994. No such independent fisheries monitoring has occurred within Angola. While independent fishery monitoring provides more reliable estimates of river fish stocks and biodiversity, the FA team does not believe that the cost of launching such monitoring is warranted given the low probabilities of observing detectable river-wide effects due to the size of the intervention. Recent research has begun using proxies of fishing activity and production, such as satellite-derived estimates of chlorophyll concentration, from earth observation data to estimate fish abundance[77] and production.[78] The third monitoring approach is to use household income, expenditure, and consumption survey data

[74] Elliott, Victoria L., Phen Chheng, Sophorn Yu, and Gordon W. Holtgrieve. "Monitoring of Tropical Freshwater Fish Resources for Sustainable Use." Journal of Fish Biology 94, no. 6 (2019): 1019-1025. https://doi.org/10.1111/jfb.13974

[75] ACADIR (2022). *Okavango Upper Catchment Cuito and Cubango Rivers Baseline Fish and Fisheries Assessment Field Report.*

[76] Rago, P.J., S.E. Wigley, M.J. Fogarty, "NEFSC bycatch estimation methodology: Allocation, precision and accuracy. *Northeast Fisheries Science Center Reference Document* (2005): NOAA FINSS.

[77] Al-Abdulrazzak, D., and Daniel Pauly. "Managing Fisheries from Space: Google Earth Improves Estimates of Distant Fish Catches." ICES Journal of Marine Science 71, no. 3 (2014): 450-454. https://doi.org/10.1093/icesjms/fst178.

[78] Deines, Andrew, David Bunnell, Mark Rogers, David Bennion, et al. "The Contribution of Lakes to Global Inland Fisheries Harvest." Frontiers in Ecology and the Environment 16, no. 6 (2017): 293-298. https://doi.org/10.1002/fee.1503

on fish consumed in the household to estimate inland fish catch.[79] The FA team does not recommend relying on household income, expenditure, and consumption survey data to estimate inland fish catch—because part of the goal of SA1 is to encourage communities to move away from subsistence fishing and such a method would not capture fish caught and sold at market.

[79] Fluet-Chouinard, E., S. Funge-Smith, and P.B. McIntyre. "Global Hidden Harvest of Freshwater Fish Revealed by Household Surveys." Proceedings of the National Academy of Sciences of the United States of America 115 (2018): 7623-7628. https://doi.org/10.1073/pnas.1721097115

Annex C: Overview of Evaluation Approaches

IEs measure the causal impact of a program. In other words, the difference in outcomes caused by the program and not by other external factors. The FA team considered not only IEs, but a variety of evaluation approaches as part of the feasibility assessment. This included (1) experimental approaches, which measure the causal impact of randomization, (2) quasi-experimental, which also attempt to measure the causal impacts but without randomization, and (3) non-experimental approaches, which can answer descriptive questions about differences but cannot measure causality with the same degree of rigor or confidence. The latter includes PEs which generally include before-after comparisons without a rigorously defined counterfactual,[80] and case studies, which include in-depth learning through extensive description and analysis.[81] The table below includes a high-level summary of different approaches that were considered:

Type	Approach	Description
Experimental	RCT	Random assignment (e.g., a coin toss or random number generator) determines who may participate in the program so that those assigned to participate in the program are, on average, the same as those who are not, in both observable and unobservable ways. Since the participants and nonparticipants are comparable, except that one group received the program, any differences in outcomes result from the causal effect of the program.
Quasi-Experimental	DiD	Measure the before-and-after change in outcomes for the program participants, then subtract the before-and-after change in outcomes of the non-participants to find the relative change in outcomes for the program participants. This methodology is only valid when if the program had not existed, the participants and non-participants would have experienced identical trajectories during the study period (i.e., parallel trends assumption).
	Statistical Matching	Individuals who received a program are compared to similar individuals who did not receive it. Comparison groups can be constructed with different techniques including exact matching and propensity score matching. This methodology is only valid if

[80] USAID, "Performance Evaluation Designs", Accessed February 17, 2022, https://www.usaid.gov/project-starter/program-cycle/project-monitor-evaluation-plan/monitor-evaluation-plan-evaluation-component/performance-evaluation-designs.
[81] USAID, "Technical Note: Evaluative Case Studies," November 2013, https://usaidlearninglab.org/sites/default/files/resource/files/usaid_case_study_tech_note.pdf.

		characteristics that were not included in matching either do not affect outcomes or do not differ between participants and non-participants.
Non-Experimental	Performance Evaluation	Performance evaluations, as defined in ADS 201, encompass a broad range of evaluation methods. They often incorporate before-after comparisons but generally lack a rigorously defined counterfactual. Performance evaluations may address descriptive, normative, and/or cause-and-effect questions such as the following: questions about project or activity results or outcomes; implementation processes and their effectiveness; what has been sustained since a project or activity ended; how cost-effective was the program compared to existing practice or another approach; was the project or activity viewed as being relevant, or given positive ratings by intended beneficiaries; were men/women, or elderly, or poor, differentially affected by the project or activity.
	Case Study	According to the widely used U.S. Government Accountability Office definition: "Case study as an evaluation method is a means of learning about a complex instance, based on a comprehensive understanding of that instance obtained through extensive description and analysis of that instance taken as a whole and in its context." Benefits of case studies include their flexibility of use, efficiency, dealing with multiple interventions, and addressing context. The evaluative case study is best used when the major questions are "how" or "why" questions.

A mixed-method evaluation integrates two or more evaluation methods, usually drawing on both quantitative and qualitative data.[82] Mixed-methods evaluations may use multiple designs, for example incorporating both RCT experiments and case studies. They also may include different data collection techniques such as structured observations, key informant interviews, household surveys, and reviews of existing secondary data. Mixed methods designs can strengthen an evaluation by (1) using different methods to answer different evaluation questions, or (2) using different methods to answer the same questions (increasing confidence in the validity/reliability of results). Generally, mixed methods evaluations can provide a deeper understanding of why change is/not occurring and capture a wider range of perspectives.

[82] USAID, "Technical Note: Conducting Mixed-Method Evaluations," June 2013, https://www.usaid.gov/sites/default/files/documents/1870/Mixed_Methods_Evaluations_Technical_Note.pdf

Annex D: Planned Program Activities by Location

Community Name	Municipality	Primary IP	Planned Activities [a]	Targeted for Intervention in Year 1 [b]	Listed in Year 1 Workplan [c]
Ndumba	Cuito Cuanavale	ACADIR	Fisheries + Sustainable agriculture	Unclear	No
Kambamba	Cuito Cuanavale	ACADIR	Fisheries + Sustainable agriculture	Unclear	No
Sihuru Kandendele	Cuangar	ACADIR	Fisheries + Sustainable agriculture	Yes	Yes
Massaka	Cuangar	ACADIR	Fisheries + Sustainable agriculture	Yes	Yes
Serengany	Cuangar	ACADIR	Fisheries + Sustainable agriculture	Yes	Yes
Malengue	Cuchi	ACADIR	Sustainable agriculture	Unclear	No
Kambungo	Cuchi	ACADIR	Sustainable agriculture	Unclear	No
Lilambo	Cuchi	ACADIR	Sustainable agriculture	Unclear	No
Bairro S. Jose	Menongue	DW	WASH	Unclear	Yes
Aldeia de Cachimbo	Menongue	DW	WASH	Unclear	Yes
Aldeia de Ndumdo	Menongue	DW	WASH	Unclear	Yes

Community Name	Municipality	Primary IP	Planned Activities [a]	Targeted for Intervention in Year 1 [b]	Listed in Year 1 Workplan [c]
Aldeia de Kanhongo	Menongue	DW	WASH	Unclear	Yes
Aldeia de Tchihongo	Menongue	DW	WASH	Unclear	Yes
Aldeia de Mabaiya	Menongue	DW	WASH	Unclear	Yes
Aldeia de Savipanda	Menongue	DW	WASH	Unclear	Yes
Aldeia de Mbundo	Menongue	DW	WASH	Unclear	Yes
Aldeia Cambinda Kamanjolo	Menongue	DW	WASH	Unclear	Yes
Aldeia de Chipompo	Menongue	DW	WASH	Unclear	Yes
Missao Catolica de Senge	Cuchi	DW	WASH	Unclear	Yes
Aldeia de Luassenha	Cuchi	DW	WASH	Unclear	Yes
Aldeia Ondumba Camonu	Cuchi	DW	WASH	Unclear	Yes
Aldeia de Cuelei	Cuchi	DW	WASH	Unclear	Yes
Bairro Canhota	Cuchi	DW	WASH	Unclear	Yes
Aldeia Cayugu	Cuchi	DW	WASH	Unclear	Yes
Aldeia de Chilanda Ngombe	Cuchi	DW	WASH	Unclear	Yes
Bairro Licolo	Cuchi	DW	WASH	Unclear	Yes
Aldeia de Chiengo	Cuchi	DW	WASH	Unclear	Yes
Bairro Gome	Cuchi	DW	WASH	Unclear	Yes
Samaria	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes

Community Name	Municipality	Primary IP	Planned Activities [a]	Targeted for Intervention in Year 1 [b]	Listed in Year 1 Workplan [c]
Cambamba	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Bairro Matias	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Bingo Bingo	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Bairro Novo	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Mawengo	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Samiquite	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Sangombe	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Quango	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Livimbi	Cuito Cuanavale	ADPP	Unclear	Unclear	Yes
Longa Sede	Longa	ADPP	Unclear	Unclear	Yes
Chingondola	Longa	ADPP	Unclear	Unclear	Yes
Caqueque	Longa	ADPP	Unclear	Unclear	Yes
Tchissende	Longa	ADPP	Unclear	Unclear	Yes
Tchungango Cungo	Longa	ADPP	Unclear	Unclear	Yes

[a]Fisheries and Sustainable agriculture activities are SA1 activities while WASH is SA2. For ADPP, all activities are unclear. In-country meetings revealed that ADPP was taking more of a participatory approach in which villages decided what interventions to receive. That approach makes it difficult to incorporate these locations into an *ex-ante* evaluation design.

[b]The Year 1 workplan included a comprehensive list of communities, but the FA team's understanding is that the full set of communities will not be targeted in Year 1. In-country meetings revealed that DW planned to target six communities per year, but it is unclear which communities are being targeted when.

[c]ACADIR provided a fuller list of Year 1 communities than provided in the Year 1 workplan. The FA team is unclear if all of these are indeed ECCO communities.

Annex E: Existing Data on Targeted Communities

No	Name	Municipality	Primary IP	SA1 or SA2	Distance from municipality head-quarters (km)	Dist. to river (km)	Have school?	Potable water source	#of health centers	Pop.
1	Sihuru Kandendele	Cuangar	ACADIR	1	76	0.5	Yes	Yes	1	650
2	Massaka	Cuangar	ACADIR	1	80	1	No	No	0	850
3	Serengany	Cuangar	ACADIR	1	96	0.5	No	No	0	500
4	Samaria	Cuito Cuanavale	ADPP	?	2	0.8	Yes	Yes	1	1014
5	Cambamba	Cuito Cuanavale	ADPP	?	3	2	Yes	Yes	1	547
6	Bairro Matias	Cuito Cuanavale	ADPP	?	67	1	Yes	No	0	982
7	Bingo Bingo	Cuito Cuanavale	ADPP	?	12	0.6	Yes	No	0	520
8	Mawengo	Cuito Cuanavale	ADPP	?	10	0.9	Yes	No	0	300
9	Bairro Novo	Cuito Cuanavale	ADPP	?	26	1	Yes	Yes	1	5000
10	Samiquite	Cuito Cuanavale	ADPP	?	28	1	No	No	0	700
11	Sangombe	Cuito Cuanavale	ADPP	?	43	1	Yes	No	0	486
12	Quango	Cuito Cuanavale	ADPP	?	39	3	No	No	0	523

No	Name	Municipality	Primary IP	SA1 or SA2	Distance from municipality head-quarters (km)	Dist. to river (km)	Have school?	Potable water source	#of health centers	Pop.
13	Livimbi	Cuito Cuanavale	ADPP	?	17	0.5	No	No	0	749
14	Longa Sede	Longa	ADPP	?	0	0.9	Yes	Yes	1	3657
15	Chingondola	Longa	ADPP	?	9	0.7	No	Yes	1	523
16	Caqueque	Longa	ADPP	?	18	1	No	No	0	1203
17	Tchissende	Longa	ADPP	?	28	2	No	No	0	318
18	Tchungango Cungo	Longa	ADPP	?	19	1	No	No	1	1310
19	Bairro S. Jose	Menongue	DW	2	4		Yes	Yes	0	500
20	Aldeia de Cachimbo	Menongue	DW	2	7		Yes	Yes	1	250
21	Aldeia de Ndumdo	Menongue	DW	2	45		Yes	Yes	1	6992
22	Aldeia de Kanhongo	Menongue	DW	2	145		Yes	Yes	1	350
23	Aldeia de Tchihongo	Menongue	DW	2	9		Yes	Yes	1	500
24	Aldeia de Mabaiya	Menongue	DW	2	5		No	Yes	1	366
25	Aldeia de Savipanda	Menongue	DW	2	4		Yes	Yes	1	500
26	Aldeia de Mbundo	Menongue	DW	2	90		Yes	Yes	1	390

No	Name	Municipality	Primary IP	SA1 or SA2	Distance from municipality head-quarters (km)	Dist. to river (km)	Have school?	Potable water source	#of health centers	Pop.
27	Aldeia Cambinda Kamanjolo	Menongue	DW	2	70		Yes	Yes	0	500
28	Aldeia de Chipompo	Menongue	DW	2	30		Yes	Yes	1	350
29	Missao Catolica de Senge	Cuchi	DW	2	12		Yes	Yes	0	858
30	Aldeia de Luassenha	Cuchi	DW	2	27		Yes	Yes	0	2600
31	Aldeia Ondumba Camonu	Cuchi	DW	2	31		No	Yes	0	402
32	Aldeia de Cuelei	Cuchi	DW	2	54		No	Yes	0	2373
33	Bairro Canhota	Cuchi	DW	2	7		No	Yes	0	709
34	Aldeia Cayugu	Cuchi	DW	2	41		No	Yes	0	2000
35	Aldeia de Chilanda Ngombe	Cuchi	DW	2	38		No	Yes	0	402
36	Bairro Licolo	Cuchi	DW	2	1		No	Yes	0	915
37	Aldeia de Chiengo	Cuchi	DW	2	25		No	Yes	0	2000
38	Bairro Gome	Cuchi	DW	2						