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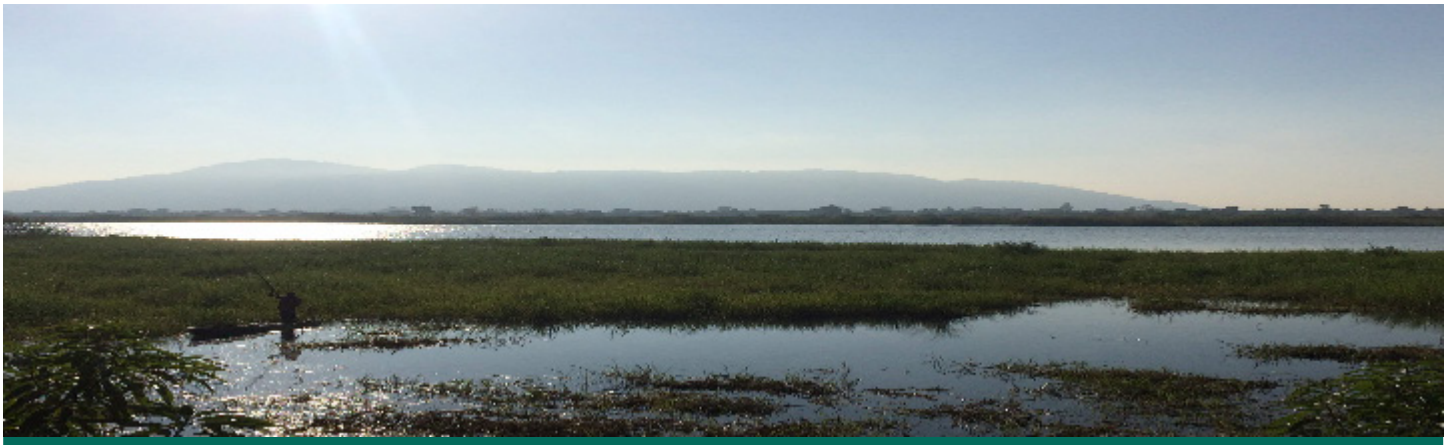

# INTERIM REPORT FOR EVALUATION OF THE ENRM PROJECT IN MALAWI

**November 6, 2019**

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Mathematica strives to improve public well-being by bringing the highest standards of quality, objectivity, and excellence to bear on the provision of information collection and analysis to our clients. This mixed-methods evaluation reflects the independent assessment of its authors who have no potential conflicts of interest, to their knowledge, in evaluating the ENRM project. The evaluation is funded by the Millennium Challenge Corporation, a U.S. government agency.

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# TABLES

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# ACRONYMS LIST

| | |
|---|---|
| AG Care | Assemblies of God Care |
| BAU | Business as usual |
| CA | Conservation Agriculture |
| CBO | Community Based Organisation |
| CCJP | Catholic Commission for Justice and Peace |
| CHIRPS | Climate Hazards Group InfraRed Precipitation with Station |
| CICOD | Circle for Integrated Community Development |
| cro2gra | Cropland to grasslands |
| cro2shr | Cropland to shrublands |
| DEM | Digital elevation model |
| EGENCO | Energy Generation Company of Malawi |
| ENRM | Environment and Natural Resources Management |
| ESCOM | Electricity Supply Corporation of Malawi |
| FISD | Foundation for Irrigation and Sustainable Development |
| for2gra | Forest to grasslands |
| for2shr | Forest to shrublands |
| GHG | Greenhouse gas |
| gra2cro | Grasslands to cropland |
| gra2shr | Grasslands to shrublands |
| Ha. | Hectare |
| HRU | Hydrologic response units |
| IGBP | International Geosphere-Biosphere Programme |
| IUCN | International Union for Conservation in Nature |
| LCC | Land cover change |
| LSMS | Living Standard Measurement Survey |
| MCA-Malawi | Millennium Challenge Account Malawi |
| MCC | Millennium Challenge Corporation |
| MEET | Malawi Environmental Endowment Trust |

| | |
|---|---|
| MERA | Malawi Energy Regulatory Authority |
| Mha | Million hectares |
| MMDT | Millennium Development Trust |
| MNREM | Ministry of Natural Resources, Energy and Environment |
| MODIS | Moderate Resolution Imaging Spectroradiometer |
| MoU | Memorandum of understanding |
| MWK | Malawi Kwacha |
| M&E | Monitoring and Evaluation |
| NGO | Non-Governmental Organisation |
| PES | Payment for ecosystem services |
| RCM | Regional climate model |
| RCP | Representative Concentration Pathway |
| REFLECT | Regenerated Frerian Literacy through Empowering Community Techniques |
| SGEF | Social and Gender Enhancement Fund |
| shr2cro | Shrublands to cropland |
| shr2wet | Shrublands to wetlands |
| SLM | Sustainable land management |
| SRTM | Shuttle Radar Topography Mission |
| SWAT | Soil and Water Assessment Tool |
| TA | Traditional Authority |
| THP | The Hunger Project |
| TSP | Training Support for Partners |
| USAID | United States Agency for International Development |
| VNRMC | Village Natural Resources Management Committee |
| VSL | Village Savings and Loans |
| wet2gra | Wetlands to grasslands |
| WOLREC | Women's Legal Resources Centre |
| WSM | Weed and Sediment Management |

# EXECUTIVE SUMMARY

## A. Overview of the ENRM project

The Shire River, Malawi's main waterway and the source of 90 percent of the country's electricity generation capacity, has undergone major transformation over the past 25 years. Changing climate, demographics, and—especially—land use practices have accelerated sedimentation and aquatic weed growth in the river, and as sediment floats downstream it gets more concentrated. This hampers hydropower generation at Malawi's three main power plants: Nkula, Tedzani, and Kapichira. Hydropower plants use adjacent head ponds to regulate the water flow they need to generate power, and water levels must be high enough and the flow free of substantial debris if the plant is going to operate efficiently and continuously. By the end of 2013, Malawi was using only 72 percent of its generation capacity, partly due to excessive weeds and sediments (MCC 2019). The Millennium Challenge Corporation (MCC) and the Millennium Challenge Account-Malawi (MCA-Malawi) identified a lack of consistent, reliable, and affordable electricity as a key constraint on Malawi's economic growth.

To address this issue, MCC funded and MCA-Malawi implemented (as part of the larger Malawi compact) the Environmental and Natural Resources Management (ENRM) project. The project, implemented from September 2013 through September 2018, encompassed three activities designed to reduce costly disruptions and increase the efficiency of hydropower generation by mitigating aquatic weed growth and sedimentation in the Shire River Basin:

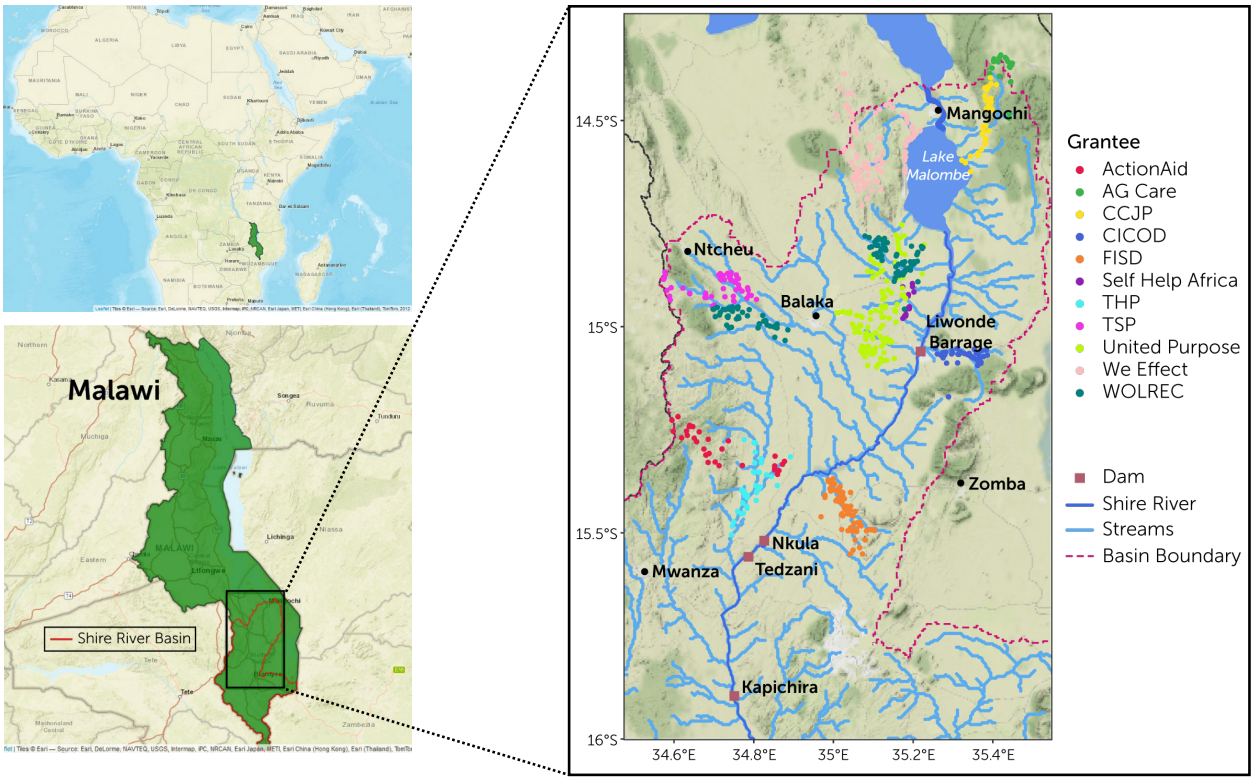
a. **The Weed and Sediment Management (WSM) activity** focused on a technical fix to the immediate problem of the excessive sedimentation in the head ponds of power plants and the voluminous weeds floating in the Shire River upstream. The activity involved procuring and using mechanical equipment to remove sedimentation and aquatic weed infestation along key areas in the Shire River, and was carried out in coordination with the Electricity Generation Company of Malawi (EGENCO).

b. **The ENRM activity** focused on the underlying technical causes of accelerated sediment runoff and weed growth: land management practices in the Shire River Basin. The activity supported grants to programs that reduce soil erosion by improving land management practices in high-priority catchment areas. Grant activities included producing mulch, diversifying crops, planting trees and vetiver grass, constructing box ridges and contour ridges, and developing ENRM action plans at the village level.

c. **The Social and Gender Enhancement Fund (SGEF) activity** was implemented in tandem with the ENRM activity. The SGEF activity aimed to address the socioeconomic root causes of poor land management, including gender imbalances in access to economic resources, division of labor within the household, limited economic opportunities, and a lack of female participation in community decision making. The activity provided grants for programs in the same catchment areas as the ENRM activity that help women and other vulnerable groups engage in more sustainable land use practices and improve their decision-making power and social outcomes.

MCA-Malawi established a **grant facility** to fund ENRM and SGEF activities through a competitive application process. The activity ended up supporting 11 three-year grants. As part of the ENRM activity, MCC also intended to support the establishment of an **environmental trust** to provide sustainable funding for land management activities and to promote gender equity in the Shire River Basin once the compact closed down**.** The grant facility also functioned as a way to pilot the types of interventions that the trust was supposed to continue supporting. Figure ES.1 shows the locations of the power stations along the Shire River, the Liwonde barrage, and the villages that the 11 ENRM and SGEF grantees focused on.

**Figure ES.1. Map of ENRM project locations**




The ENRM project aimed to tackle the problem of sedimentation and weed infestation in three ways: (1) focusing on the immediate problem of removing weed and sediment near hydroelectric power plants (WSM activity); (2) combating the root causes of soil runoff in the Shire by promoting sustainable land management (ENRM and SGEF activities); and (3) planning for long-term investments in behavior change by establishing an environmental trust.

MCC contracted with Mathematica Policy Research to conduct an independent evaluation of the overall ENRM project and the individual project activities. This report gives the interim evaluation findings, addressing research questions on project implementation, outcomes, and sustainability for each activity.

## B. Research questions and evaluation methods

To evaluate the ENRM project, we tailored a rigorous mixed-methods evaluation approach to each activity to answer the corresponding research questions while accommodating any constraints around the timing of activity implementation, the structure of the intervention, and data availability. Table ES.1 summarizes the main research questions, data sources, and outcomes for each activity's evaluation design. The complete list of research questions for each activity is listed in the corresponding results chapter in this report. The evaluation approaches are aligned with the evaluation design report (Coen et al. 2018) with the exception of an adjustment to the WSM activity evaluation. Since activity implementation was not complete at the end of the compact, the interim evaluation was unable to assess the effectiveness of the activity using an interrupted time series or pre-post design. We expect to be able to apply the planned evaluation approach for this activity in the final evaluation report. The evaluation of the ENRM and SGEF grants is described and reported on in a companion volume—Velyvis et al. (2019).

**Table ES.1. ENRM project evaluation: Summary**

| Activity: evaluation method | Main research questions[a] | Data sources | Key outcomes |
|---|---|---|---|
| **WSM activity:** performance evaluation[b] | 1. How was the activity implemented?<br>2. How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity?<br>3. What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity? | • KIIs with MCA-Malawi, MCC, and EGENCO staff<br>• Site visits to power stations<br>• Water quality data and EGENCO power station and weed harvesting data<br>• Environmental assessment reports | • Water turbidity<br>• Weeds harvested and weed management costs<br>• Facilitators and barriers to implementation and sustainability |
| **Grant facility activity:** performance evaluation | 1. How was the grant facility activity implemented?<br>2. Which objectives from the grant facility manual were achieved by the grant facility, and which were not? Why not? | • KIIs with MCA-Malawi, MCC, and grant program staff<br>• Grant facility documentation and data, including grant evaluation criteria, grant reports and evaluations, and monitoring data<br>• Activity location and geospatial data<br>• Environmental assessment reports | • Factors considered in the grant selection process<br>• Proximity of grant activities to environmental features<br>• Cross-cutting activity outputs<br>• Facilitators and barriers to implementation and grant oversight |

| Activity: evaluation method | Main research questions[a] | Data sources | Key outcomes |
|---|---|---|---|
| **Environmental trust:** performance evaluation | 1. What implementation factors supported or hindered the establishment of the trust?<br>2. To what extent is the trust on track to reach administrative and operational sustainability? | • KIIs with trust board of directors, MCA-Malawi, MCC, and program implementation staff<br>• Trust document review | • Results from taking recommended steps in feasibility study<br>• Facilitators and barriers to implementation and sustainability |
| **ENRM project:** geospatial modeling and performance evaluation | 1. How has land use along the Shire River changed during the ENRM project?<br>2. If the project activities were expanded throughout the area, how would the activities affect sedimentation in the Shire River based on alternative modeling scenarios?<br>3. Which implementation factors supported or hindered the effectiveness of the ENRM project overall?<br>4. Did the ENRM project achieve its targeted intermediate and final outcomes and contribute to higher-level compact objectives? Why or why not?<br>5. What are stakeholders' perceptions of how sustainable the outcomes achieved under the ENRM project are, and what are their reasons for those perceptions? | • Modeling data including high spatial resolution mapping, digital elevation, land cover, land management, precipitation and temperature, and streamflow<br>• Findings from each activity-level evaluation<br>• Project documentation including compact close-out documents<br>• KIIs with MCA-Malawi, MCC, and program implementers | • Changes in land cover classification<br>• Changes in soil runoff into the Shire and in hydropower production<br>• Synthesis of activity results |

[a] Chapters on the results of each activity include the complete list of research questions for the corresponding activity.

[b] For the final evaluation, we will also use an interrupted time series or pre-post design to estimate how the WSM equipment affected power plant operations and restored active storage to the head ponds after the dredging equipment becomes operational.

KIIs = Key informant interviews.

A performance evaluation was our main methodological approach for each interim activity evaluation: a rigorous mixed-methods approach to descriptively answer the relevant research questions. This approach allows us to assess how well each activity performed in producing its expected outputs and outcomes. We collected cross-cutting quantitative and qualitative data for these analyses, including key informant interviews with staff at MCC, MCA-Malawi, and the activity implementer; data on water quality, power generation, and weed management; geospatial and activity location data in the Shire River Basin; site visits; grant monitoring data; and an extensive review of documents from MCA-Malawi, MCC, and activity implementers. After addressing the activity-level research questions on implementation, outcomes, and sustainability, we synthesized findings to assess the overall ENRM project, and modeled sedimentation changes over the entire Shire River Basin. By design, the 11 grants implemented under the grant facility lacked the scale to produce a measurable effect on hydropower generation. To assess how

scaling up similar interventions across the entire Shire River Basin would affect soil erosion, sedimentation and hydropower generation, we used the Soil and Water Assessment Tool (SWAT), a hydrological transport model. It provides an integrated framework to simulate hydrologic, water quality, and agricultural production processes and represents the spatiotemporal variability of these processes.

## C. Summary of key findings

Overall, we found that the ENRM project achieved many of its intended outputs and that its structure aligned with the project's theory of change. At the same time, with the compact only closing in September 2018 and the outputs for the WSM and trust activities yet to be fully operational, it is too early to assess overall project performance. We found that selecting and overseeing contractors impeded both the WSM and trust activities. Ultimately, less equipment was procured for the WSM activity than planned, but the dredger at the Kapichira could still improve the efficiency of hydropower generation at that plant. However, implementation delays have left it up to EGENCO and MCA-Malawi's follow-on agency—the Malawi Millennium Development Trust—to see this activity through and to start dredging. At this time, the ENRM project has yet to have a measurable effect on its main objective: reducing siltation and weed infestation in the Shire River. Table ES.2 presents key findings for the interim evaluation by activity and research question.

**Table ES.2. ENRM Project evaluation summary**

| Main research questions | Key interim findings |
|---|---|
| **WSM activity evaluation** | |
| 1. How was the activity implemented? | • Equipment delivery was significantly delayed because of poor contractor selection and performance, leading to cancellation of the procurement of a dredger for the Nkula power station.<br>• EGENCO proved to be a supportive partner for activity implementation and was engaged and invested in equipment procurement and training, but, as of the close of the compact, the newly procured equipment had not yet been put into operation. |
| 2. How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity? | • EGENCO has developed equipment sustainability plans that call for stocking sufficient spare parts, training appropriate staff, and conducting regular service checks.<br>• Whether the equipment is maintained and continues to be operable depends on stakeholder commitment and resource availability. |
| 3. What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity? | • EGENCO and the GoM have committed funds to implement the WSM activity, but EGENCO faces substantial risks in achieving its capital dredging plan for the Kapichira power station and properly disposing of the dredged sediments. |

| Main research questions | Key interim findings |
|---|---|
| **Grant facility evaluation** | |
| 1. How was the grant facility activity implemented? | • The facility was well designed to allow for activity experimentation in order to identify effective SLM interventions. However, it was also constrained by a three-year intervention window and cost-reimbursement contracts that slowed some aspects of grant implementation.<br>• MCA-Malawi conducted a thorough and detailed process to identify the most qualified grant applicants, but, at times, it relied on subjective criteria and undocumented decisions.<br>• MCA-Malawi was able to conduct rigorous financial and programmatic grant oversight, but, particularly on the programmatic side, staff members were overwhelmed by the volume of work in the absence of sufficient resources, a consequence of the grant facility structure.<br>• Most of the villages selected by grantees were located in or near prioritized areas, based on environmental features identified in the Middle and Upper Shire Baseline Assessments and Action Plan.<br>• Despite the benefits of and drawbacks to many alternative grant facility structures, MCA-Malawi could have designed its grant facility to benefit from greater synergies with the planned environmental trust. As the trust is not yet operational, it is unclear how much, if any, of the grant facility's operational structure and intervention evidence the trust will use. |
| 2. Which objectives specified in the grant facility manual were achieved by the grant facility and which were not, and why? | • When soliciting and approving grant proposals, the grant facility followed the main recommendations in the baseline environmental reports in terms of activity type and location (LTS International et al. 2010, 2011, 2013, 2014a, 2014b, 2014c).<br>• The grant facility exceeded the output targets it tracked, including the number of trees survived, the number of leaders trained in ENRM, and the number of operational REFLECT circles and Village Savings and Loan (VSL) groups. However, the grant facility did not have the resources, capacity, or a plan to obtain high quality data on important measures such as the number of farmers adopting SLM practices. Many grants also did not cover the entire agricultural value chain.<br>• The grant facility succeeded in pushing all grantees to integrate ENRM and SGEF activities—a novel approach—though grantees adjusted their activity mix depending on their technical expertise. Some grantees focused more heavily on ENRM activities while others concentrated more on SGEF activities.<br>• The grant facility supported activity scale-up and raised awareness about the seriousness of the soil erosion problem by generating evidence as to activity effectiveness, creating linkages with other donors and government stakeholders. However, it is too early to tell if these outcomes will be sustained given that the trust is not yet operational and the compact has closed. |

| Main research questions | Key interim findings |
|---|---|
| **Environmental trust evaluation** | |
| 1. What implementation factors supported or hindered establishment of the trust? | • Early lack of agreements between MCC and MCA-Malawi as to how to structure the trust and grant facility delayed trust implementation. The effort involved in establishing the grant facility diverted the resources otherwise required to develop the environmental trust. Those factors, along with poor contractor implementation, left too little time for successfully establishing and operationalizing the trust prior to the close of the compact.<br>• The trust has a functional board of directors made up of the key stakeholders for land management in the Shire River Basin. However, board members have limited availability for their tasks and need permanent technical staff to push the trust forward. After we completed data collection for this report, the trust identified a board member to serve as trust coordinator<br>• MERA approved an increase in the environmental management levy for EGNECO, and MCC reported a deal in principle whereby EGENCO and the Electricity Supply Corporation of Malawi (ESCOM) will pay for initial trust operations through the electricity levy. After we completed data collection for this report, EGENCO signed a one-year agreement with the trust to provide funding at a level lower than in the approved levy. ESCOM has not provided a formalized, written commitment to fund the trust. |
| 2. To what extent is the trust on track to reach administrative and operational sustainability? | • It is uncertain if the trust will be successfully launched and sustained in the coming years. It has key supporters in Malawi and prospects for sufficient capital, but it will need a strong champion outside of MCA-Malawi and MCC if it is to advance from an idea to reality. Leadership is a key factor for the trust's success. |
| **ENRM project evaluation** | |
| 1. How has land use along the Shire River changed during the ENRM project? | • Close to 7 percent of land area in the Shire River Basin experienced land cover change between 2015 and 2017, with overall trends suggesting deforestation and cropland expansion. A large share of deforested area is located in high-slope areas, and agricultural land is encroaching onto riverbanks. The evidence suggests that areas facing high erosion risk are being converted to biomes that exacerbate soil erosion. |
| 2. If the project activities were expanded throughout the area, how would the activities affect sedimentation in the Shire River based on alternative modeling scenarios? | • We modeled a policy scenario consistent with GoM's land restoration targets and found that the adoption of sustainable land management practices would reduce sediment inflow for the Nkula, Tedzani, and Kapichira reservoirs by 30 to 40 percent relative to a business-as-usual scenario. If these practices were adopted continuously for 20 years, the three plants would avert total losses of between 28 and 36 MW of hydroelectric production capacity due to sedimentation at the end of the period as compared to the business-as-usual scenario. |
| 3. Which implementation factors supported or hindered the effectiveness of the ENRM project overall? | • All activities were aligned with the project's theory of change; however, MCA-Malawi, with MCC's support, was implementing an ambitious set of activities for a five-year compact and had limited experience in procuring dredging equipment and setting up a trust in Malawi.<br>• MCA-Malawi, with MCC's substantial support, demonstrated strong implementation flexibility as they adjusted to conditions on the ground, particularly poor contractor performance. |
| 4. Did the ENRM Project achieve its targeted intermediate and final outcomes and contribute to higher-level compact objectives? Why or why not? | • As the project has yet to effect a reduction in weeds and sediment in the Shire River, it is too early to assess higher-level outcomes on power generation and reliability. In fact, in the final quarter of the compact, average power plant utilization was a disappointing 55 percent, well below the compact target of 90 percent. |

| Main research questions | Key interim findings |
|---|---|
| 5. What are stakeholders' perceptions of the sustainability of outcomes achieved under the ENRM project, and why? | • At the close of the compact, key stakeholders remained committed to project activities. The GoM has committed resources to see activities through to completion, but it is too early to tell if project outputs and outcomes will be sustained. |

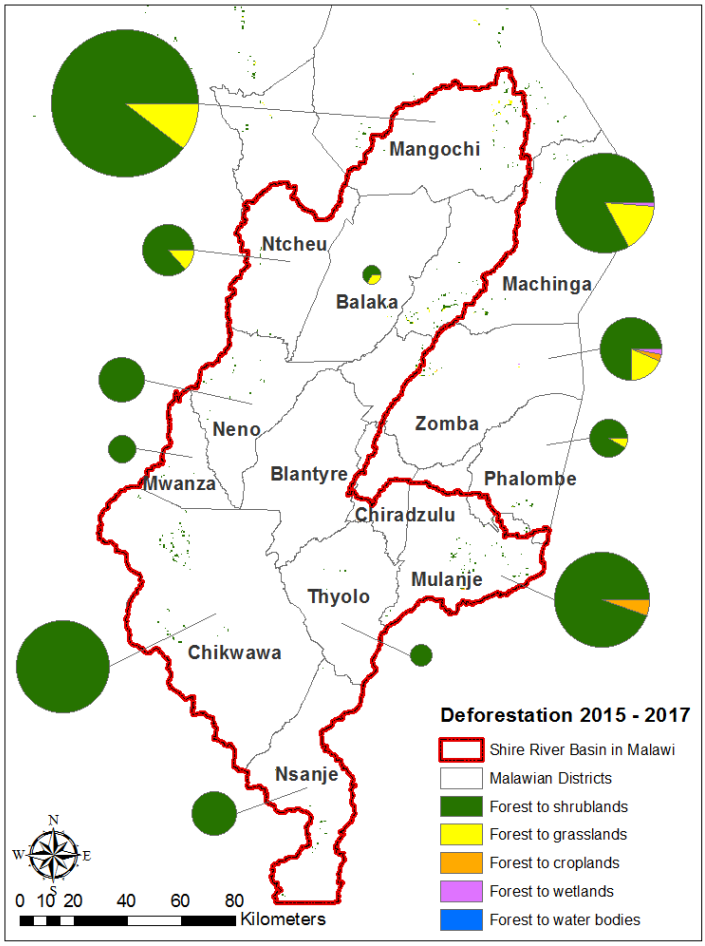
## D. Conclusion

The ENRM project was designed to address three main issues that hampered the performance of the hydropower plants: overflow of weeds and sediment at or near the power plants (WSM activity), underlying environmental and social causes of soil runoff in high-priority communities (ERNM and SGEF activities), and long-run planning to change land management behavior practices at scale in the Shire River Basin (environmental trust). The inability of the project to fully implement the WSM activity as planned compromised a key pillar of the program logic—that the activity could effectively address the sedimentation problem that was immediately affecting hydropower generation. The effect of the WSM activity was also limited by its failure to procure a dredger at Nkula, which was intended to help with the sediment problem at both Nkula and nearby Tedzani. In the final quarter of the compact, average plant utilization was a disappointing 55 percent. This was much lower than the target amount of 90 percent, and it was measured during the dry season when weeds and sediment generally have the least effect on power plant operations. EGENCO still cited low water levels, plant maintenance, and high levels of weeds and sedimentation as reasons for the low utilization rate (MCC 2019).

MCA-Malawi was able to implement the grant facility, providing grants to 11 organizations to address the environmental and social root causes of poor land management in high priority areas of the Shire River Basin. However, MCA-Malawi, with MCC's substantial support, was unable to establish the environmental trust, which was the project's key sustainability mechanism to achieve long-run reductions in sediment yield. While at the end of the compact, the trust existed on paper only, after we completed data collection for this report, the trust board did name a full-time coordinator, establish a bank account, identify office space, and sign a one-year agreement with EGENCO for some initial operational funding. Still, the trust currently lacks sufficient funding resources and there is substantial risk that the trust will not turn into the large grant-making organization that the compact intended it to be. Without ongoing activities to improve land management practices throughout the Shire River Basin, communities are unlikely to change their behavior in a way that would have positive long-term environmental effects. Although the WSM equipment can address the immediate technical problems at Kapichira and the Liwonde barrage, it will be ineffective without a continued focus on the root environmental causes of sediment runoff and weed growth.

At the same time, the landscape of the Shire River Basin is still being transformed. Land cover change took place in close to 7 percent of the basin's area between 2015 and 2017, with trends suggesting accelerated deforestation and cropland expansion that exacerbated soil erosion (Figure ES.2). Although the ENRM project was well designed to address both short-term

**Figure ES.2. Deforestation in the Shire River Basin, 2015–2017**




Note: We derived values by using the MODIS Land Cover Type Product (Friedl and Sulla-Menashe 2019) only for those portions of districts that are inside the Shire River Basin boundary (red). Pie sizes correspond to total area deforested, and pie slices indicate relative shares.

technical problems and longer-run challenges requiring community-wide behavior change, it is unclear if the activities will be sustained beyond the compact to achieve the project's intended objectives of increasing the efficiency of hydropower and the reliability of electricity.

## E. Next steps

We will collect a second round of qualitative and administrative data in 2020 to examine whether activities that extended beyond the close of the compact took place as they were intended to (for the WSM and trust activities) and whether outcomes such as behavioral changes in communities near the Shire River were sustained by the grant facility. For instance, we will answer research questions we were unable to address during the interim evaluation, including for the WSM activity:

1. To what extent did the activity restore active storage at the hydropower plants during the compact and after it ended?
2. Did the new weed harvesters and dredgers affect power plant operations during the compact and after it ended?

We plan to conduct interviews with ENRM and SGEF grant beneficiaries, staff and board members of the environmental trust, and EGENCO power plant operators. We will also be collecting updated data from EGENCO on power plant operations as well as climate, water quality, and land cover data for geospatial analysis and modeling. Our final evaluation report will be issued in mid-2021.

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# I. INTRODUCTION

To reduce poverty in Malawi through equitable and sustainable economic growth, the Millennium Challenge Corporation (MCC) funded a $350.7 million energy sector compact with the Government of Malawi (GoM). MCC and the Millennium Challenge Account-Malawi (MCA-Malawi) identified a lack of consistent, reliable, and affordable electricity as a major constraint to Malawi's economic growth. MCA-Malawi implemented the compact from September 20, 2013, through September 20, 2018. The compact consisted of three projects: (1) the Infrastructure Development project, designed to rehabilitate and modernize Malawi's power system ($260.2 million); (2) the Power Sector Reform project, which undertook institutional and regulatory reform to improve the regulatory framework and energy policy environment ($27.5 million); and (3) the Environmental and Natural Resources Management (ENRM) project, which worked to reduce costly disruptions and increase the efficiency of hydropower generation by mitigating aquatic weed growth and sedimentation in the Shire River Basin ($19.9 million).[1]

Malawi is unique in that 98 percent of its electricity comes from hydropower, primarily from three power plant sites along the Shire River. Efficient electricity generation from those plants requires communities upstream in the Shire River Basin to engage in sustainable land management (SLM) practices. However, poverty, population density, and a lack of suitable agricultural land, among other reasons, have increased sediment runoff and weed growth in the Shire River, inhibiting hydropower production. The ENRM project is designed to (1) address these environmental and fundamental economic causes that result in inefficient hydropower production and (2) directly remove sediment and weeds around important generation areas.

MCC contracted with Mathematica Policy Research to conduct an independent evaluation of the overall ENRM project as well as of individual project activities. In this report, we provide interim evaluation findings, addressing research questions on project implementation, outcomes, and sustainability for each activity. We employ a rigorous mixed-methods framework that is tailored to each activity's evaluation. We base our findings on an analysis of several data sources, including key informant interviews with MCC and MCA-Malawi staff and activity implementers, administrative data from the Electricity Generation Company (EGENCO) and other agencies, geospatial and land use/land cover data that characterize the Shire River Basin, and an extensive document review. Challenges with sustainable land management are not unique to Malawi or even to the southern Africa region. Our findings can be useful in informing policymakers, donors, and other stakeholders about the effectiveness of different land management interventions, along with providing lessons on implementation and sustaining behavior change. In the rest of this chapter, we provide an overview of the ENRM project, including a description of the project's logic and theory of change.

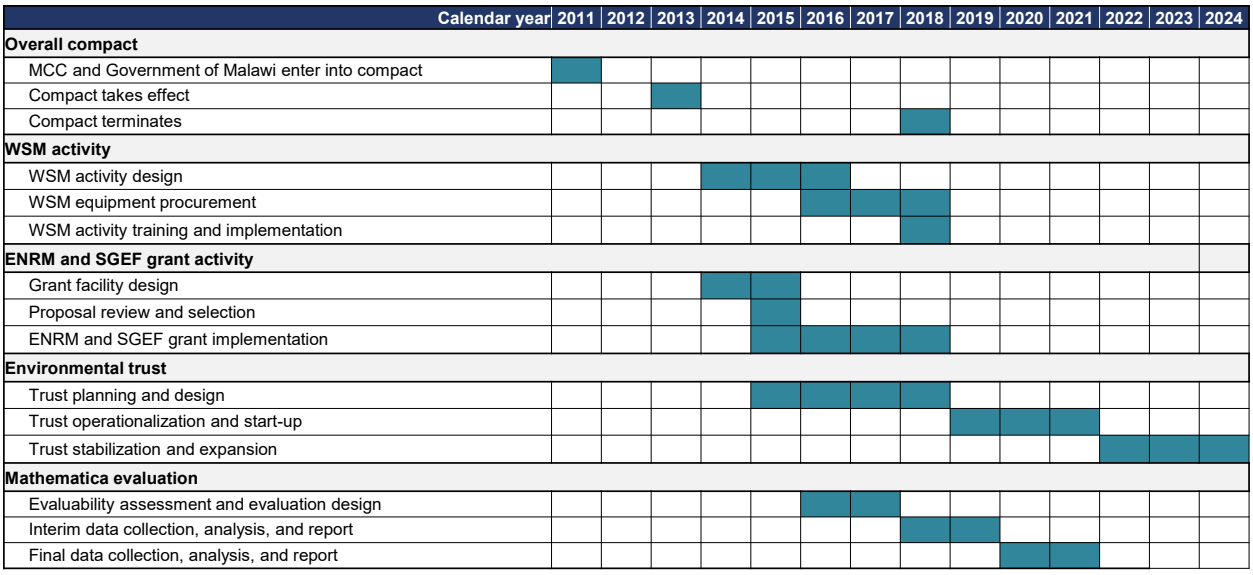
[1] The compact budget also included $36.1 million for program administration and $6.9 million for monitoring and evaluation.

(continued)

## A. Overview of the ENRM project

The ENRM project focused on excessive sedimentation and aquatic weed growth in the Shire River, which is exacerbated by poor land use practices. The sedimentation and weeds in the Shire River cause substantial disruptions to three hydroelectric power plants along the river that produce around 90 percent of Malawi's power: Nkula, Tedzani, and Kapichira.[2] Ultimately, the disruptions in electricity generation decrease the reliability of Malawi's electricity supply. Three activities under the ENRM project were designed to address this issue: (1) the Weed and Sediment Management activity (WSM; $15.9 million), (2) the ENRM activity ($10 million), and (3) the Social and Gender Enhancement Fund (SGEF) activity ($2 million). In addition, the ENRM project sought to establish an environmental trust (as part of the ENRM activity) to continue the funding of activities beyond the compact's conclusion for programs that address sustainable land management and social and gender barriers in the Shire River Basin. Below, we briefly review each of these activities and, in Figure I.1, summarize the timeline for ENRM project activities and for Mathematica's evaluation.

**Figure I.1. ENRM project timeline**




**The WSM activity** focused on a technical fix to the immediate problem of excessive sedimentation in the head ponds of power plants and excessive weeds floating in the Shire River upstream. The activity involved procuring and using mechanical equipment to remove sediment and aquatic weed infestations along critical areas of the river. The WSM activity aimed to benefit

[2] The installed capacity at the Nkula, Tedzani, and Kapichira hydropower plants are 124 megawatts (MW), 92.7 MW, and 129.6 MW, respectively. The only other hydropower plant that is currently operational in the country is the Wovwe power station; it is located in the Karonga district on the Wovwe River and has a relatively small installed capacity of 4.35 MW. Two other large hydropower plants in Malawi are in the planning stage. The Songwe hydropower plant, to be jointly owned with Tanzania, will be located in the Mbeya district on the Songwe River, with an expected capacity of 180 MW (90 MW will be available to Malawi). The Mpatamanga hydropower plant with a planned capacity of 258 MW will be located in the Blantyre district on the Shire River; it will be downstream of Nkula and Tedzani but upstream of the Kapichira hydropower plant.

households and businesses directly through an increased power supply, thereby improving electricity reliability and reducing blackouts and brownouts. Under the activity, MCA-Malawi purchased dredging and sediment disposal equipment for the Kapichira power station and procured weed removal equipment for the EGENCO site at the Kamuzu barrage in Liwonde. In addition, EGENCO staff were trained to operate and maintain new dredging and sediment removal equipment and agreed to maintain and continue to train staff in use of the equipment after termination of the compact.

**The ENRM activity** focused on the underlying technical causes of increased sediment runoff and weed growth: poor land management practices in the Shire River Basin. The activity supported grants to programs that reduce soil erosion by improving land management practices in high-priority (or "hot spot") catchment areas that were identified in baseline assessment reports as particularly large contributors to excessive soil runoff in the Shire (LTS International et al. 2010, 2011, 2013, 2014a, 2014b, 2014c). Grant activities included mulch production, crop diversification, planting of trees and vetiver grass, construction of box ridges and contour ridges, and development of ENRM action plans at the village level. The objective of these activities is to introduce land management practices that reduce sediment runoff while improving crop yields.

**The SGEF activity** was implemented synergistically with the ENRM activity. The SGEF activity addressed the fundamental socioeconomic causes of poor land management. It provided grants for programs in the same catchment areas as for the ENRM activity and aimed to help women and vulnerable groups engage in more sustainable land use practices and improve decision-making power and social outcomes. The grant programs also worked with communities to develop alternative economic opportunities outside of charcoal production. Besides their focus on women, the grants supported programs that worked with men who have limited control of resources in a matrilineal society—all part of a broader activity objective of strengthening inclusive household and community decision making. Activities included conducting business skills, leadership, and gender equality trainings, organization of community REFLECT Circles[3] that often included a literacy development and numeracy component, and the creation of Village Savings and Loan (VSL) groups and environmental management or forestry groups. MCA-Malawi also developed technical assistance manuals on REFLECT circles and VSLs to help grantees integrate gender equality and sustainable land management principals into these activities.

MCA-Malawi established a **grant facility**, detailed in its grant manual (MCA-Malawi 2014a), to fund ENRM and SGEF activities through a competitive application process that identified the most effective intervention approaches. Grant programming took place within 12 catchment areas (7 in the Upper Shire and 5 in the Middle Shire) identified in the baseline assessment

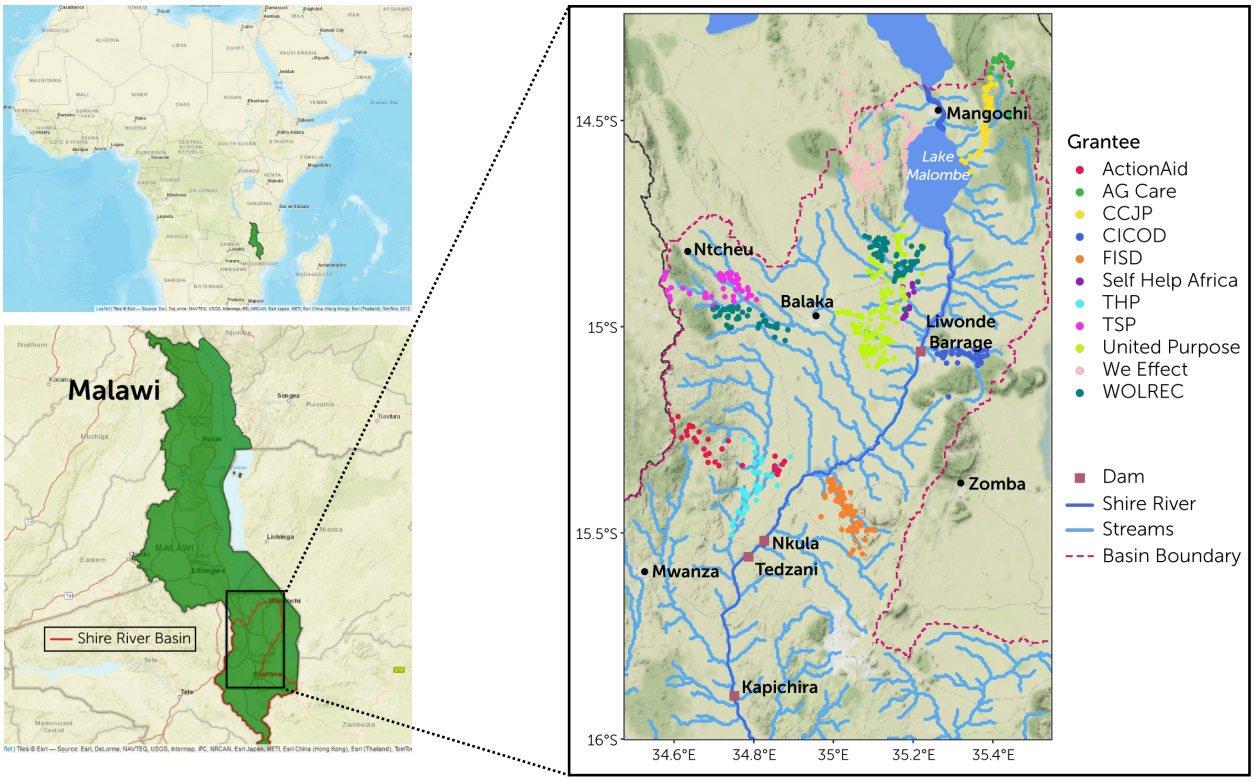
[3] REFLECT (Regenerated Frerian Literacy through Empowering Community Techniques) Circles aimed to bring community members together to discuss issues the participants identified as important, ensuring that people's voices could be heard equally and that participants continually analyzed dynamics of power within their communities (ActionAid 2017; Reflect 2009).

(continued)

reports.[4] MCA-Malawi received 57 grant applications and ultimately funded 11 three-year grants that covered 4 of the 5 high-priority catchments in the Middle Shire and 4 of the 7 high-priority catchments in the Upper Shire. Four catchment areas accounted for two grantees that conducted programming in the same priority area. Grant implementation concluded in July 2018.

In general, each grantee carried out a similar set of overlapping activities that addressed both ENRM and SGEF objectives, though some grantees focused more extensively on particular objectives. The grantees conducted activities in 771 villages encompassing 22 Traditional Authorities (TAs). Each grant operated in 20 to 127 villages and 1 to 3 TAs (MCC 2018). In Figure I.2, we show the locations of the power stations along the Shire, the Liwonde barrage, and the villages targeted by the 11 ENRM and SGEF grantees. In Appendix Table A.1, we provide summary information on the grant-implementing organizations and their associated activities.

**Figure I.2. Map of ENRM project locations**




As part of the ENRM activity, MCC intended to support MCA-Malawi in establishing an **environmental trust** to provide sustainable funding for land management activities and to promote gender equity in the Shire River Basin once the compact concluded. By the close of the compact, MCA-Malawi had helped to establish the trust, known as the Shire Basin Environmental Support Trust (Shire BEST), but the trust lacked reliable and sufficient funding,

[4] In the Middle Shire, The World Bank and MCC collectively identified 10 priority catchment areas, then split those into two groups. The World Bank focused on five of the catchment areas and MCC focused programming on the other five.

office space, and permanent staff. The work to operationalize the trust was transferred to the MCA-Malawi's successor agency: the Malawi Millennium Development Trust (MMDT).

## B. Project logic and theory of change

The ENRM project tackled the problem of sedimentation and weed infestation in three ways: (1) the immediate removal of weeds and sediment near the hydroelectric power plants (WSM activity); (2) combating the fundamental causes of soil runoff in the Shire by improving sustainable land management (ENRM and SGEF activities); and (3) planning for long-term investments in behavior change by establishing an environmental trust. These three sets of activities encompass the project's theory of change, whereby:

a. If weeds are removed and sedimentation is reduced, then the turbines in the hydropower plants will clog up less frequently and have sufficient levels of water in the reservoir to generate power, resulting in more efficient operation of power generation units with fewer power outages.

b. If community interventions are implemented, then households and communities will be better equipped to improve land use and watershed management practices, thus decreasing siltation and erosion in the project area.

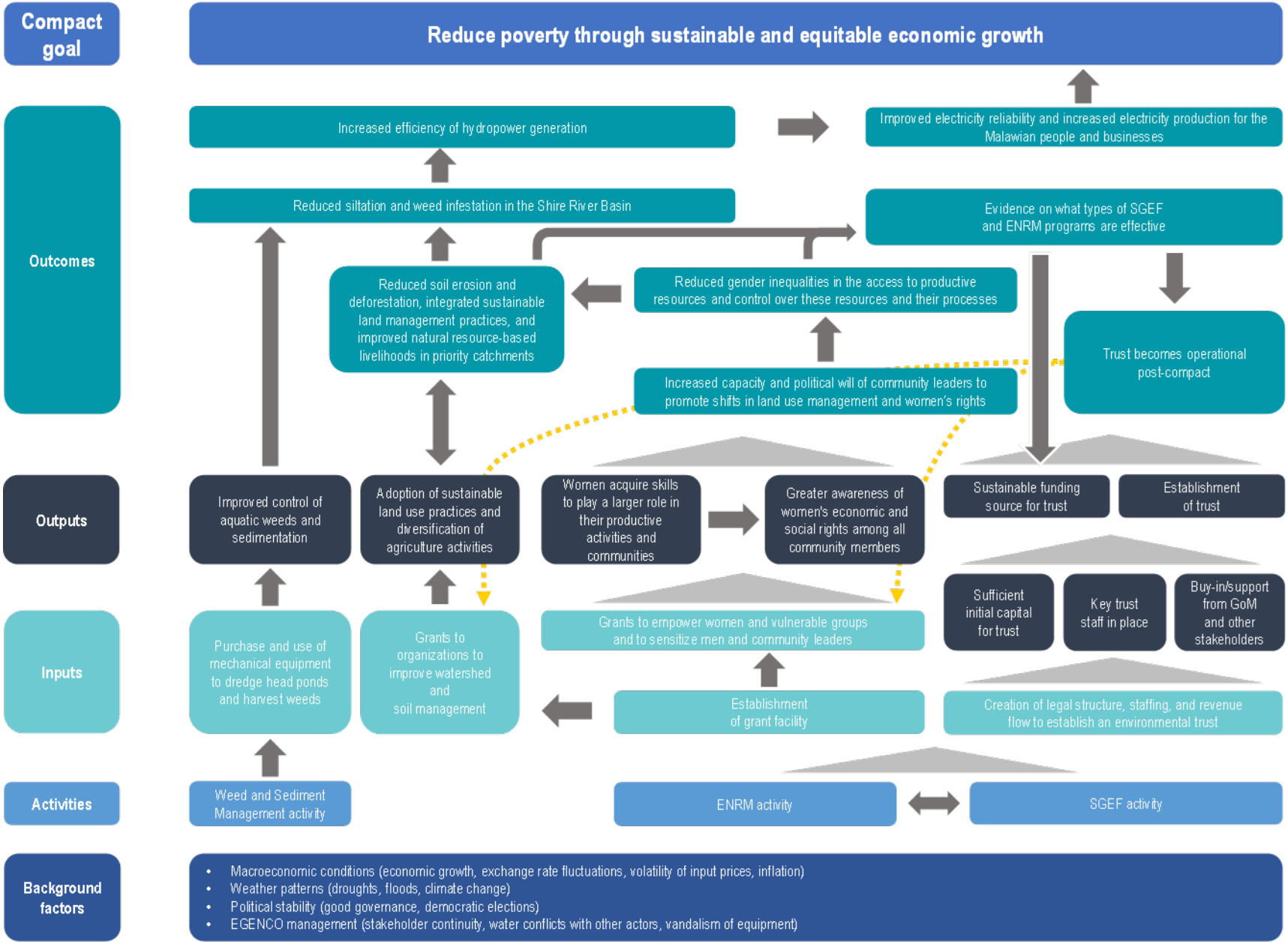
c. If an environmental trust is set up, then further initiatives and organizations can be funded, thereby leading to the sustained improvement of better land use practices that would provide continued support for more efficient hydropower generation (MCA-Malawi 2014a).

Drawing on compact documentation and discussions with MCC and MCA-Malawi staff, we summarize the project logic in detail in Figure I.3, including the background factors that affect project activities and links among inputs, outputs, outcomes, and, ultimately, the compact goal to "[r]educe poverty through sustainable and equitable economic growth by increasing the competitiveness of agricultural, commercial and industrial sectors of Malawi" (MCA-Malawi 2014c). The WSM activity addresses the immediate need to remove weeds and sediment in the Shire River and around the hydropower plants. The ENRM and SGEF activities work synergistically to combat the fundamental causes of sediment runoff and weed growth in the Shire: land management practices and underlying socioeconomic and gender-related factors in the communities. The environmental trust attempts to sustain and scale up successful ENRM and SGEF activities over the long term, recognizing that behavior change will take longer than the three-year timeline of the ENRM and SGEF grants.

We also show how connections between outputs and outcomes are not unidirectional. The success of ENRM grant programs can result in greater adoption of sustainable land use practices as farmers see and appreciate the effectiveness and benefits of such practices, thereby creating a self-reinforcing channel. The trust can use evidence of the effectiveness of ENRM and SGEF grantees to support its fund-raising efforts aimed at establishing operations while developing criteria for selecting grantees. The WSM, ENRM, and SGEF activities contribute to the main project outcomes of reduced siltation and weed infestation in the Shire, the increased efficiency of hydropower generation, and the improved reliability and increased production of electricity.

The report proceeds as follows. In Chapter II, we present a literature review of relevant evidence from southern Africa on land degradation and hydroelectric power production, conservation agriculture and sustainable land management farming practices, women's empowerment programming, and the utility of trusts for grant making. In Chapter III, we present an overview of our mixed-methods approach to evaluating each activity and the overall project, including research questions, data sources, the analytic design, and key outcomes. We then provide interim results for the WSM activity (Chapter IV), the ENRM and SGEF grant facility (Chapter V), the Environmental Trust (Chapter VI), and the overall ENRM project (Chapter VII). It is important to note that our companion report provides findings from five in-depth ENRM and SGEF grant case studies (Velyvis et al. 2019). In Chapter IX, we summarize our interim findings and discuss their implications for next steps in the evaluation, including an additional round of data collection and analysis to examine longer-term outcomes and project sustainability.

**Figure I.3. Program logic for the ENRM project**



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# II. LITERATURE REVIEW

In this chapter, to provide context for the ENRM evaluation and our interim findings, we review existing evidence related to interventions on sustainable land management and its connection to hydropower production, women's empowerment, and grant making to provide context for the ENRM evaluation and our interim findings. We end the chapter by describing gaps in the literature and how the ENRM project evaluation provides policy-relevant evidence and contributes to the existing literature.

## A. Effectiveness of erosion reduction approaches

Soil erosion is a major challenge for sustainable land management and, ultimately, hydropower generation. As sediment accumulates in the Shire River, it decreases the water volume and flow available for electricity generation. At the same time, increased soil runoff, including fertilizer runoff from agricultural land, provides a rich nutrient base for the growth of aquatic plants and weeds, which harm hydroelectric plant infrastructure (LTS International et al. 2014b). In recent years, various studies have confirmed substantial soil runoff into the Shire. Soil erosion generally results from land degradation, agricultural practices, and other human activities. It not only reduces soil fertility and productivity, but it also leads to a loss of agricultural productivity, which is of particular concern in countries such as Malawi whose economies are heavily dependent on agriculture (Asfaw et al. 2018). Yaron et al. (2011) estimate the annual on-site loss of agricultural productivity caused by soil loss in Malawi at $54 million (or 1.6 percent of GDP). Land cover is a critical determinant of soil erosion, and land cover changes such as deforestation and agricultural practices are important contributors to soil erosion and river sedimentation in many parts of the world. Studies have developed several soil erosion models to estimate soil erosion from agricultural land (Borelli et al. 2017; Montgomery DR 2007). Erosion models tend to show a linear relationship between land cover and soil erosion (Renard et al. 1991). Prevention of soil erosion through SLM practices is a common method for trying to reduce sediment inflow into rivers and hydropower reservoirs (Kondolf et al. 2014). Land management practices can improve land cover, reduce rain drop impact (FAO 1989), and, in turn, reduce runoff and soil erosion.

In addition, analyses have shown a significant potential reduction of sediment loading in river water in response to improved land management in catchment areas (Shi et al. 2019). A simulation study in Bhutan showed that, with proper SLM techniques—such as contouring, increasing forested cover, selecting proper plants, and terracing—sediment loading can be reduced by 50 percent from highland forests and 23 percent from cropland (Nkonya et al. 2016). Similarly, Ziadat and Taimeh (2013) found, based on regression analyses in arid areas of the Al-Muwaqqar watershed in Jordan with steep slopes, a 50- to 60-percent sediment loading reduction in response to the adoption of SLM practices.

### 1. Conservation agriculture

Conservation agriculture (CA), a set of soil management practices within the sustainable land management framework that minimize soil disturbance, maintain soil cover, and include rotating

crops, began as a means to control wind and water erosion (Baveye et al. 2011). Research shows that CA practices can significantly reduce wind erosion. A study conducted in Argentina concluded that improved land cover decreases wind erosion and increases soil productivity, resulting in an inverse linear relationship between wind erosion risk and the soil productivity index (Silenzi et al. 2010). CA has also proved to be effective in reducing water erosion. Trees reduce soil erosion by serving as windbreaks and decreasing the impact of raindrops, and their roots bind soil on sloping land (FAO 1989).

The Malawian government and local and international development partners have advocated CA practices as an important innovation for smallholders to increase crop yields and reduce soil erosion from wind and rain (Ngwira et al. 2014). Globally, reputable institutions, such as the Food and Agriculture Organization (FAO) of the United Nations and the International Maize and Wheat Improvement Center, have recommended CA as a promising land and soil management intervention (FAO 2011; Corbeels et al. 2014), as supported by success stories of CA in various agricultural settings (Pretty et al. 2011; Ruminamhodzi et al. 2011; Nyasimi et al. 2014). The FAO found that, in soil-loss scenarios, some of the most effective and productive practices include the adoption of vetiver grasses, terraces, and erosion control bands (Asfaw et al. 2018).

In addition, CA can deliver other ecosystem services such as carbon sequestration; increased soil fertility from decomposition of crop residues; reduction of pesticides, which pollute water; and reduction of transportation of soil nutrients, which causes eutrophication (excessive nutrient richness in water, which, in turn, causes dense plant life and death of animal life from lack of oxygen) (Palm et al. 2014; Stager et al. 2009). Evidence suggests that eutrophication enhances seedling growth of the water hyacinth, a weed infesting the Shire River and a focus of the ENRM project (Malik 2007; Wilson et al. 2007). CA practices can substantially decrease domestic, industrial, and agricultural runoff, a factor in eutrophication and weed infestation in rivers (Ebabu et al. 2019; Mironga et al. 2012). Many ENRM and SGEF grantees under the ENRM project in Malawi conducted various activities to promote CA, including box ridge and check dam construction, vetiver grass planting, and crop diversification.

Recent studies find that fewer than 2 percent of smallholder farmers in Malawi are adopting a full set of CA practices, despite evidence that CA practices can increase crop yields (Asfaw et al. 2018; Nyambose and Jumbe 2013; McNair 2013; Bisangwa 2013; Fisher et al. 2018). In addition to traditional agriculture extension approaches, other methods designed to motivate adoption of SLM practices (which have been tested in the field and were implemented by some ENRM and SGEF grantees funded under the ENRM project in Malawi) include farmer field schools (FFS) and agglomeration payments for enhanced adoption. An FFS organizes groups of farmers to meet regularly with a trained facilitator to examine the effectiveness of SLM farming practices and to demonstrate how those practices differ from traditional methods. Davis et al. (2012) showed that FFSs were more effective in promoting SLM practices and reaching women and less educated farmers as compared to traditional extension services. The latter take a more top-down approach to SLM practice promotion, such as training sessions led by government extension officers and the creation of demonstration plots.

## 2. Tree planting and forest management

About 97 percent of Malawi's population depends on firewood for cooking (Nielsen et al. 2015). Along with increased demand for firewood, agricultural land expansion into forest areas has led to deforestation and erosion in Malawi (Ngwira and Watanabe 2019; Worku, Tripathi, and Khare 2018). Between 1990 and 2010, Malawi lost 17 percent of its forest cover of 3.9 million hectares (FAO 2010). According to Elliot et al. (1999), soil erosion in primary (undisturbed) forests is generally less than 1 ton per hectare per year, but erosion can account for up to 11 tons per hectare per year due to clear-cutting or wildfires within forests. Tree-planting strategies aimed at combatting erosion in Malawi and other countries have faced challenges related to incentives (Nawir et al. 2007). Earlier tree-planting strategies used top-down approaches that required communities to plant trees but offered no rewards for tree-planting efforts (Ostrom 1999).

Tree planting is among the most effective strategies for restoring degraded lands and addressing deforestation. Trees provide forest cover, which prevents soil erosion, deliver other on-farm and off-farm benefits. Because trees and forests stabilize soils and provide cover, they are the most effective soil erosion strategy for steep slopes—which are most prone to erosion (Satriawan et al. 2015; Elliot et al. 1999; Gelagay and Mineale 2016).

Malawi formed Village Natural Resources Management Committees to enhance community participation and incentives for tree planting and to address challenges related to tree-planting and other environmental efforts within communities (GOM 1996, 2002, 2010; Wiyo et al. 2015). Such community-managed tree planting and natural regeneration have succeeded in Malawi. For example, the Uzumara Local Forest Management Board (LFMB) has established a forest reserve that is co-managed by the Department of Forestry and the Uzumara LFMB. The local community has directly and significantly benefited from the forest (Time 2017). This outcome is consistent with what has been shown to be the main drivers of successful tree planting in developing countries, namely, strong local institutions, local participation and involvement, and tree planting that responds to the socioeconomic needs of the local community (Le et al. 2012; Adedayo 2018). Tree planting was a component of all ENRM and SGEF grants.

In addition to tree planting, farmer-managed natural regeneration (FMNR) has succeeded admirably in sub-Saharan Africa because it is a low-cost practice and consistent with traditional tree management practices (Bayala et al. 2014; Reij and Garrity 2016). Through continuous management and protection of non-planted trees and shrubs on the land, FMNR allows natural regeneration of native trees and shrubs from the mature root systems of previously cleared desert shrubs and trees. In one study, adoption of FMNR practices in Niger (including pruning stems from stumps of felled trees and protecting tree seedlings) raised household income, increased crop diversity, and increased both the density and diversity of trees (Haglund et al. 2011).

## 3. Fuel-efficient cookstoves

Biomass fuel accounts for nearly 90 percent of household energy consumption in sub-Saharan Africa (Das et al. 2017). In Malawi, exposure to household air pollution caused by smoke inhalation from firewood and charcoal is associated with significantly higher rates of cardiopulmonary and neurologic symptoms, including shortness of breath, breathing difficulties,

chest pains, forgetfulness, and dizziness as compared to cooking methods that do not involve smoke inhalation from firewood and charcoal (Das et al. 2017). Fuel-efficient cookstoves can use less firewood than traditional cooking methods (thereby decreasing reliance on firewood and reducing deforestation), increase cooking efficiency, and reduce exposure to pollutants from open fires (decreasing morbidity and respiratory disease from smoke inhalation) (Jetter and Kariher 2009).

As a means of decreasing the adverse health impacts associated with the use of firewood and charcoal and to reduce greater deforestation from the collection of firewood, several grants promoted the construction and adoption of fuel-efficient cookstoves under the ENRM component of grant activities. A study conducted in Malawi shows that fuel-efficient cookstoves can reduce cooking time by 8 percent and fuelwood biomass requirements by about 45 percent compared to traditional three-stone open-fire cookstoves (Malakini and Maganga 2011). Yet, only 3 percent of the population of Malawi has adopted fuel-efficient cookstoves (Nielsen et al. 2015). This statistic is consistent with the low adoption and use of nontraditional cookstoves in the developing world, with the exception of China, thus limiting any effects on deforestation (Mobarak et al. 2012; WHO 2006; U.S. Department of Energy 2011; Smith et al. 1993; Akolgo et al. 2018).

In Malawi, NGOs are the major suppliers of fuel-efficient cookstoves, and they sell them at a subsidized price that crowds out more efficient entrepreneurs who could increase access to cookstoves (Gifford 2010; Nielsen et al. 2015). In addition, government investment in the development and dissemination of fuel-efficient cookstoves is noticeably low—a review showed that only 10 percent of investments in these stoves came from government funding, whereas 50 percent came from NGOs, 29 percent from donor-funded projects, and 11 percent from private sources (Gifford 2010).

### 4. Alternative income-generating activities

Agricultural expansion has substantially contributed to deforestation, increasing soil erosion as forests, wetlands, and savannahs are converted to croplands or pastures; agricultural land expanded by 55 percent between 1975 and 2000 in sub-Saharan Africa, while 16 percent of the forests and 5 percent of open woodlands and bushlands were lost in the same area during the same period (Maeda et al. 2010; Gibbs et al. 2010; Nkonya et al. 2013; Ngwira and Watanabe 2019). A study on the drivers of cropland expansion over the last 50 years showed that, in countries with alternative economic activities, cropland expansion was either relatively limited or cropland decreased. For example, in Botswana, Mauritius, Angola, and the Seychelles, cropland area decreased as agriculture's contribution to GDP has fallen over the past 30 years. The ENRM and SGEF grantees have implemented a variety of alternative income-generating activities to reduce pressure on deforestation and overall land degradation, such as promoting bee keeping, planting fruit trees, and providing training in business skills and marketing.

## B. Effectiveness of land degradation mitigation strategies on hydroelectric production

Hydropower is extremely important for sub-Saharan Africa. For the past five decades, hydropower has consistently accounted for more than 50 percent of the electric power consumed in sub-Saharan Africa—the highest level in the world. Malawi faces a particularly severe lack of diversification of energy sources for electricity generation. Hydropower plants provide approximately 98 percent of electricity. However, as of 2016, only 4 percent of the rural population was connected to the electric grid; others rely on biomass for energy needs, which can lead to land degradation (World Bank 2019; Taulo et al. 2015). Malawi's power supply is much lower than demand. The country's current installed generation capacity is 365MW, but estimated demand is around 440MW (World Bank 2018).

Soil runoff has adverse consequences for hydropower production. According to Morris and Fan (1998), siltation reduces about 0.5 to 1 percent of the total global volume of 6,800 $km^3$ of water stored in reservoirs annually. The reduction in live dam storage due to siltation reduces power generation (Basson 2004). In addition, sediments damage turbines and other hydropower plant equipment (Schellenberg et al. 2017). The annual global loss of hydroelectricity generation resulting from sediment loading into rivers and dam systems is estimated at $6 billion (Basson 2012). Soil and water conservation and other soil erosion control strategies with proven success in many countries have been proposed to reduce sediment loadings (Kondolf et al. 2014). For example, a study in Nigeria showed that reforestation and stone bunds reduced sediment yields by up to 66 percent (Adeogun et al. 2016).

In addition to siltation, weeds in riverways adversely affect hydropower production. Observers first noted water hyacinth, a perennial aquatic herb (Eichhornia crassipes) originating in the Amazon, in the Shire River in the 1970s, but it was not a cause for concern until the 1980s. According to Mellhorn (2014), about 140 megawatts of power are lost daily as a result of infestation by hyacinth and other weeds such as elephant grass. Water hyacinth also changes the river's habitat in other ways, including affecting the amount of light infiltration and supporting phytoremediation of toxins in the river (Zhu et al. 1999).

Dredging can help recover lost live storage; however, it is extremely costly and generally seen as a last-resort measure. A study in Nigeria showed that dredging can cost $18 per ton (Nkonya et al. 2010). Borji (2013) assessed the impact of dredging on hydropower productivity. His estimates suggest that sediments do not affect hydropower generation until silting reaches 16.6 percent or more of the mean annual runoff volume. His analysis did not, however, consider the cost savings attributed to the reduced damage to turbines and other hydropower plant equipment.

Mechanical, chemical, or biological control methods are generally used to address infestation. Phiri et al. (2001) are optimistic that, of the three measures, biological control would be an effective control method on the Shire River. For effective control of larger outbreaks, all three measures might need to be applied at once. Some evidence suggests that water hyacinth infestation adversely affects fish production; however, no conclusive study on fish production could be found for the Shire. Other potentially adverse effects of water hyacinth infestation

include increased evaporation, altered water chemistry, changes in the existence of wetland species, and the creation of a breeding ground for mosquitoes.

## C. Effectiveness of women's empowerment programming

Women's empowerment can be defined as reducing the cultural, economic, and political constraints on women's autonomy and agency, constraints that manifest themselves in persistent gender inequalities. Women's empowerment programs and interventions attempt to transform unjust and unequal power relations to enhance women's rights, power, and agency (Cornwall 2016) and should expand women's choices.

Women's empowerment is often measured in changes in access to and control of resources, such as education, employment, or political participation. However, it is the social relationships that govern access to the resource in question that determine the extent to which positive changes in women's lives are realized; in fact, increased access or control could represent positive as well as negative impacts on women's lives (Kabeer 2005). However, the measures of women's empowerment, such as household decision making, change at different rates; for example, a program may affect women's decision making about land and livestock but not affect their decision making in regard to children (Goldman and Little 2015). Past research often concludes that women's empowerment is not an outcome but rather a process that, in changing social norms, is likely to unfold over generations (Goldman and Little 2015; Mahmud, Shah, and Becker 2012). Formal changes to laws and policies and women's access to and control over resources and opportunities are important. However, the informal changes in cultural norms and women's and men's consciousness are perhaps more important for long-term, sustainable effects on women's lives (McCarthy and Kilic 2017; Sandler and Rao 2012; Nagar and Raju 2003; Goldman et al. 2016).

LTS International conducted a baseline gender and social assessment to identify and assess potential economic, social, and gender differences and inequalities in Malawi. These differences and inequalities may affect land use practices; access, control, and/or use of natural resources; or the decision making among key actors, such as smallholder farmers and other natural resource users in the ENRM project area (LTS International et al. 2014c). According to O'Sullivan et al. (2014), female farmers in Malawi use lower levels of agricultural inputs, such as fertilizer, extension services, and improved seeds, leading to a gender gap of 25 percent in agricultural productivity. In the upper and middle regions of the Shire River Basin, gendered access to and control over agricultural assets vary substantially between men and women (LTS International et al. 2014c). Access and control are lowest for female-headed households. Moreover, given the matrilineal property rights system in many parts of rural Malawi, women generally own the land and have better access to loans and extension information, but men remain the main decision makers in agriculture.

There is concern that both female-headed households and the matrilineal system in parts of the Shire River Basin contribute to soil erosion and land degradation (LTS International et al. 2014c). Female-headed households have insufficient resources (especially cash and male labor) to manage their land sustainably—for example, through conservation agricultural methods,

including adequate organic and chemical fertilizer applications. Soil loss affects female-headed households more markedly than it affects male-headed households; a 1 percent reduction in soil loss translates to a 0.39 percent loss in maize productivity for female-headed households, while the same reduction in soil loss translates to a 0.23 percent loss in maize productivity for male-headed households (Asfaw et al. 2018). Moreover, within the matrilineal system, even though women hold the land rights, men make most of the agricultural decisions related to crop choice, inputs, and production. However, men reportedly have a limited interest in managing farmland sustainably—including addressing soil erosion challenges—because they have weak tenure security and are expected to leave the village in the case of divorce or the death of the wife. Thus, despite their land rights, women cannot sustainably manage agricultural lands. Place et al. (2001) show differential outcomes by gender, noting that, in Malawi, male farmers in patrilineal/patrilocal land systems had decision making power over their own land and were more likely than female farmers in matrilineal/matrilocal communities to invest in destumping and tree planting. Gender inequalities in the distribution of decision-making power shape the outcomes even when land ownership is equal. It is important, therefore, to understand for this evaluation how the perceptions and behavior of men and women have changed as a result of the SGEF interventions, and how any behavior changes have affected within-household decision making.

Given the extent to which women, particularly poor women, have been marginalized in processes by which development policies are designed and implemented, the identification of gender issues is an important step in the use of the MCA-Malawi SGEF grant activities to improve women's control and management of natural resources. A number of activities were funded to support women's empowerment and land management, including REFLECT Circles, VSL groups, and trainings in business and leadership for women.

### 1. REFLECT Circles

One of the interventions implemented by the SGEF and ENRM grant facility is REFLECT Circles (Regenerated Frerian Literacy through Empowering Community Techniques), which use a participatory approach to adult learning and social change (ActionAid 2017; Reflect 2009). The circles focus on bringing male and female community members together to discuss important issues identified by the participants, ensuring that people's voices are heard equally and that participants continually analyze power dynamics. The circles facilitate empowerment by creating a space for people to establish collective voices to assert their rights and change their position in society; such an activity is especially important to permit male and female community members to discuss gender-based issues and solutions in the context of their communities. REFLECT Circles use education as a tool for empowerment. They have helped women learn about their rights and build the strength to use their knowledge to assert their rights (for example, ActionAid 2017). The REFLECT process also aims to strengthen all people's capacity to communicate (Archer and Goreth 2004). REFLECT Circles have been used in more than 70 countries (Reflect 2009), and, in the grants funded by MCA-Malawi, they sought to help empower women and enhance communication between women and men— with the aim of managing land more jointly and sustainably.

REFLECT Circles have been helpful in managing natural resources and supporting sustainable agriculture. With an international strategy objective to promote sustainable agriculture and control over natural resources for people living in poverty, the REFLECT organization focuses on seven pillars, including gender equity and women's rights, soil conservation, sustainable water management, and supporting farmers' organizations (Marcatto and Chung 2016). A case study in India showed how REFLECT Circles helped deal with drought in a very poor district. The district viewed drought as a political issue that related more to the distribution of land and access to food, local knowledge, and information than to the amount of rainfall. Responses to the drought through the REFLECT Circles included land management techniques (Reflect 2009). In case studies in Bangladesh, Uganda, and El Salvador, REFLECT Circles helped local populations change their natural resource management practices (Archer and Cottingham 1996).

### 2. Village savings and loans

VSLs constitute a decentralized, noninstitutional, savings-led approach to microfinance in which members provide their own savings and credit services at very low cost while retaining earnings and capital within their communities (Allen and Panetta 2010). SGEF grantees worked in communities to establish VSLs, which are a relatively common development intervention in Malawi—a catalyst for improved gender relations, women's leadership, and community development. Contradicting earlier findings, recent rigorous evaluations of VSLs showed very little impact on individual empowerment and community engagement, although the results could reflect how survey questions were framed to measure these outcomes (Gash and Odell 2015).

VSLs can be effective platforms for supporting other development services by delivering programs to VSL members through the group. Evidence to support VSLs' usefulness has been positive (Gash and Odell 2015). An example of such an effort in Malawi is the Misuku Hills Improved Livelihood and Biodiversity Conservation Project, which aims to raise awareness of the value and importance of the area's biodiversity while building capacity for sustainably harvesting and selling forest products through VSLs (CEPF 2015). Other similar projects include one in Niger that supports women's acquisition of new skills to enable communities to become more resilient to climate change while investing in VSLs (Guilbert 2017). A project in Ghana addresses issues of environment and natural resource management and the formation of VSLs to pool savings and make investments to protect natural resources (IPA 2019). In Malawi, one study found positive and significant effects of participation in VSL groups on the number of meals consumed per day and household expenditure, linking participation to outcomes such as increases in savings and credit obtained through VSL groups, agricultural investments (including purchases of seeds and fertilizer), and income from small businesses (Ksoll et al. 2016). However, additional evidence that VSLs enhance welfare is still emerging, as rigorous research has been funded only since 2008.

### 3. Other SGEF activities

Training represents another means for the delivery of SGEF interventions, including training in literacy, business and marketing skills for women, and leadership (for advocacy and lobbying). Studies see adult functional literacy and numeracy as essential for women's empowerment (for example, IFAD 2000), although literacy remains a challenge for many women in developing

countries (UNESCO 2013). Literacy programs can be included in agriculture projects to improve women's agriculture outcomes, self-esteem, and confidence, which can be important components of sustainable empowerment programming (Deo 2012). Training women in business and marketing skills (along with supporting access to capital) and helping women develop the skills needed to expand their economic options can promote women's economic empowerment. However, prior rigorous studies of such interventions targeting poor women in developing countries also show the limitations of such an approach with few effects on business survivorship or profits. Some noted constraints include the extent of household chores for women and their lack of agency in household decision-making (Buvinić and Furst-Nichols 2016; Woodruff and McKenzie 2013). Finally, leadership training for advocacy and lobbying is an important component to increasing women's empowerment and participation in land management and other economic activities (Dejene 2007). Advocacy and lobbying training are a means to build civil society's capacity to influence decision makers and provide participants with the tools they need to lobby effectively for policies important to women (see for example, International Knowledge Network of Women in Politics, 2019) . Such leadership training has found application in many areas, such as health and welfare, political participation, labor, and human rights. As women continue to be underrepresented in leadership positions in political, social, and economic spheres, the gaps in women's leadership will continue to undermine women's rights as well as sustainable development (Duflo 2012). Training in all three spheres can give women the skills needed to improve gender inclusion in civil society.

Finally, some grant activities that aimed to improve joint decision making focused on community engagement and sensitization of men to equal gender relations. As noted, unless changes occur in cultural norms and men's and women's consciousness, any changes in the roles attained by women or the resources controlled by women may not improve the quality of women's lives and may not be sustained (Goldman and Little 2015; Goldman et al. 2016). However, true changes in norms—brought about by an increase in women's decision-making authority, a key goal of the grant facility—can improve women's lives outside the home and realign the balance within household decision making (Ribot and Peluso 2003; Marcus 2018; Bandiera et al. 2018).

## D. Utility of grant facilities and trusts for grant making

Many donor-driven programs similar to the ENRM project failed following project termination (Swidler and Watkins 2009). In this section, we examine the drivers of successful financing as well as the challenges faced in grant making for sustainable natural resource management.

Environmental trust funds in sub-Saharan Africa have been one of the most common grant making programs. Bladon et al. (2014) reviewed 12 conservation trust funds in developing countries and concluded that the major drivers of their success included strong feasibility studies, diversified financing, strategic and financial planning, strategic partnerships, political support, financial expertise, and strong reporting, monitoring, and evaluation.

Snowdon (2004) also emphasize the importance of evaluation and analysis as critical conditions for successful grant making. Strategic partnerships or external support to enhance the capacity of grantees is consistent with Ostrom (1990), who views strategic external support as essential to

address capacity deficits in grassroots organizations. Such support enhances sustainability and encourages learning and reflection. However, the external support should be designed with an exit strategy to ensure that grantees graduate from such support. Grant priorities should also be aligned with national development priorities (Halimanjaya et al. 2014). In addition, Dear (2016) and an evaluation of the International Climate Fund by the UK's Department for International Development (2014) suggests that donors, beneficiaries, government, and other key stakeholders need to understand the risks of grant making, prepare themselves to bear them, and work together to minimize them. The African Women's Development Fund (Chléirigh 2015) suggests that two-way communication and flexibility in design, structure, and operations are essential to address evolving challenges. Finally, organizational and capacity development of grantees is a factor in success (DFID 2014).

The challenges associated with grant making are closely related to factors of successful grant making. Lack of quantitative data for evaluation and analysis is one of the chief factors undermining success and effectiveness. Related to the data issue, lack of information management systems is another challenge (Chléirigh 2015). The low capacity of grantees to handle a variety of complex projects also remains a major challenge to grant making.

## E. Gaps in literature and policy relevance of the ENRM project evaluation

Some of the activities funded by the ENRM and SGEF grant facility lack rigorous evidence on their effectiveness. For example, there is limited evidence on the efficacy of many programs seeking to address social and gender barriers. A few studies track long-term changes in women's empowerment, but the standards in a given study are often not relevant across several cultural contexts (Beteta 2006; O'Hara and Clement 2018). There is also limited literature on the trade-offs associated with conservation agriculture (CA) interventions, disaggregated by gender. CA interventions do not guarantee that women will spend less time on household labor; in some cases, as a result of CA interventions, the need for plowing (traditionally done by men) is eliminated, but land preparation responsibilities (traditionally the province of women) increase. Thus, economic costs and benefits as a result of CA interventions are not guaranteed to be gender-neutral (Milder et al. 2011). Our evaluation will add to the literature on these activity areas, and we will compare results across grants with respect to types of training and intervention methods.

The ENRM project evaluation provides important lessons for environmental and social and gender strategies to improve hydropower production in Malawi and in similar contexts. Hydropower accounts for almost all grid power in Malawi, and infestation of the water hyacinth in waterways has been well documented, but there are only limited studies on the effects of water hyacinth growth on hydropower generation. Malawi experiences an average of 7.4 power outages per month, with each outage lasting an average of 3.6 hours (Ramachandran et al. 2018). It is estimated that the annual cost of power cuts due to siltation, power rationing, and other factors is about US$215 million (Reuters 2010) or 3.3 percent of the country's GDP of US$6.404 billion (World Bank 2019). It is also estimated that siltation and reduced water flow reduces about 10 to 12 percent of power generation from the Shire River hydropower plants

(Government of Malawi 2013). The country's growing energy needs and its energy policies are placing additional pressure on power generation and distribution.

The high costs of soil runoff and weed growth in the Shire River have important policy implications for Malawi. The Malawi government and its development partners recognize that unless soil erosion in the Shire River resulting from human-induced activities is addressed, weeds and sediment will continue to cause operational costs and threaten hydroelectric generation for the country. This evaluation is therefore pertinent because it will contribute to the much-needed evidence on effective land management interventions and natural resource programs that can alleviate erosion and sediment yields in the Shire River, Malawi's main catchment basin. It is normally difficult to generate rigorous evidence on the effects of environmental activities on hydropower generation because the interventions are usually not at a scale sufficient to affect power plants, as is the case with the ENRM and SGEF grants. However, we are able to estimate the effects of such interventions at scale by modeling changes in sediment yields throughout the Shire River Basin based on different scenarios for adoption of land management practices and climate change. Within these scenarios, we estimate the savings in reservoir storage and hydroelectric production capacity.

Beyond modeling changes in sediment yield at scale, this evaluation provides an understanding of why communities do or do not adopt certain land management practices and points to the key factors in their decision-making process. We focus on prevention and alleviation of siltation from upstream land management practices and on rehabilitation efforts (through dredging) to restore the capacity of the water reservoir at hydropower plants. Through in-depth case studies, the evaluation provides qualitative evidence of the erosion and sediment reduction potential of various land management practices under different catchment conditions, along with evidence on gender-based interventions undertaken jointly with ENRM activities. This information will be useful in providing guidance to stakeholders involved in management of the Shire River Basin, specifically for the selection and promotion of sub-basin–specific natural resource management interventions that contribute to erosion control. MCC and MCA-Malawi have supported grantees that have implemented soil erosion control interventions; however, information on their effects is lacking. Our evaluation also fills information gaps on the efficacy of SLM practices, informing the emerging environmental trust, the Malawi government, donors, and other project stakeholders about effective SLM interventions. These results could also be useful to other countries in the region that are grappling with similar human-created environmental challenges.

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# III. EVALUATION METHODOLOGY

The evaluation of the ENRM Project in Malawi encompasses separate evaluations for the WSM activity, the ENRM and SGEF grant facility, the ENRM and SGEF grants, and the Environmental Trust, as well as an evaluation of the overall ENRM project. We tailored a rigorous mixed-methods evaluation approach to each activity to answer the corresponding research questions while accommodating the constraints related to activity timing, the structure of the intervention, and data. The evaluation approaches are aligned with the evaluation design report (Coen et al. 2018) with the exception of an adjustment to the WSM activity evaluation. Since activity implementation was not complete at the end of the compact, we were unable to assess the effectiveness of the activity using an interrupted time series or pre-post design for the interim evaluation. We expect to be able to apply the planned evaluation approach for this activity in the final evaluation report.

In Table III.1, we summarize the main research questions, data sources, and outcomes for each activity's evaluation design. (The ENRM and SGEF grants evaluation appears in a companion volume; see Velyvis et al. 2019). In addition to the main research questions, each evaluation contains research sub-questions targeted to activity implementation, outcomes, and sustainability. We listed those research sub-questions in the results chapter for each activity.

After addressing the activity-level research questions on implementation, outcomes, and sustainability, we synthesized findings to provide an assessment of the overall ENRM project, in conjunction with modeling sedimentation changes over the entire Shire River Basin. We employed a performance evaluation as our main methodological approach for each activity evaluation. We relied on a rigorous mixed-methods approach to descriptively answer the relevant research questions. The performance evaluation allowed us to assess whether and the extent to which each activity produced its expected outputs and outcomes. We collected cross-cutting quantitative and qualitative data for these analyses, drawing on key informant interviews with MCC, MCA-Malawi, and activity implementer staff; water quality, power generation, and weed management data; geospatial and activity location data in the Shire River Basin; site visits; grant monitoring data; and an extensive document review from MCA-Malawi, MCC, and activity implementers. We now provide more details on our qualitative and quantitative data collection and our analytic approaches for our performance evaluation.

## Table III.1. ENRM project evaluation summary

| Activity: Evaluation method | Main research questions[a] | Data sources | Key outcomes |
|---|---|---|---|
| **WSM activity:** Performance evaluation[b] | 1. How was the activity implemented?<br>2. How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity?<br>3. What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity? | • KIIs with MCA-Malawi, MCC, and EGENCO staff<br>• Site visits to power stations<br>• Water quality data and EGENCO power station and weed harvesting data<br>• Environmental assessment reports | • Water turbidity<br>• Weeds harvested, weed management costs<br>• Facilitators and barriers to implementation and sustainability |
| **Grant facility activity:** Performance evaluation | 1. How was the grant facility activity implemented?<br>2. Which objectives from the grant facility manual were and were not achieved by the grant facility, and why? | • KIIs with MCA-Malawi, MCC, and grant program staff<br>• Grant facility documentation and data, including grant evaluation criteria, grant reports and evaluations, and monitoring data<br>• Activity location and geospatial data<br>• Environmental assessment reports | • Factors considered in the grant selection process<br>• Proximity of grant activities to environmental features<br>• Cross-cutting activity outputs<br>• Facilitators and barriers to implementation and grant oversight |
| **Environmental trust:** Performance evaluation | 1. What implementation factors supported or hindered the establishment of the trust?<br>2. To what extent is the trust on track to reach administrative and operational sustainability? | • KIIs with trust board of directors, MCA-Malawi, MCC, and program implementation staff<br>• Trust document review | • Results from taking recommended steps in feasibility study<br>• Facilitators and barriers to implementation and sustainability |
| **ENRM project:** Geospatial modeling and performance evaluation | 1. How has land use along the Shire River changed during the ENRM project?<br>2. If the project activities were expanded throughout the area, how would they affect sedimentation in the Shire River per alternative modeling scenarios?<br>3. Which implementation factors supported or hindered the overall effectiveness of the ENRM project?<br>4. Did the ENRM project achieve its targeted intermediate and final outcomes and contribute to higher-level compact objectives? Why or why not?<br>5. What are stakeholders' perceptions of the sustainability of outcomes achieved under the ENRM project, and why? | • Modeling data including high spatial resolution mapping, digital elevation, land cover, land management, precipitation and temperature, and streamflow<br>• Findings from each activity-level evaluation<br>• Project documentation including compact close-out documents<br>• KIIs with MCA-Malawi, MCC, and program implementers | • Changes in land cover classification<br>• Changes in soil runoff into the Shire and in hydropower production<br>• Synthesis of activity results |

[a]Complete research questions for each activity appear in the relevant results' chapter.

[b]For the final evaluation, after the dredging equipment becomes operational, we will also estimate how the WSM equipment affected power plant operations and restored active storage to the head ponds using an interrupted time series or pre-post design.

KIIs = Key informant interviews

## A. Performance evaluation

We conducted a rigorous performance evaluation of each ENRM project activity to examine activity implementation, outputs and outcomes, and prospects for sustainability. MCC defines a performance evaluation as a descriptive study that addresses project objectives, achievements, implementation, sustainability, and other research questions related to project design, management, and operational decision making (MCC 2017). With the performance evaluations presented in this report, we were able to examine whether an activity achieved or did not achieve its intended outputs and outcomes and what factors supported or inhibited implementation of the activity. By collecting several types of data and from a variety of stakeholders, we triangulated between sources by systematically categorizing and sorting the data to identify key themes and patterns in the responses while recognizing similarities and differences in perspectives. We next describe our qualitative, quantitative, and administrative data collection, followed by an explanation of our analytic approaches for the performance evaluation of each activity.

### 1. Qualitative data collection

To answer our research questions, we collected qualitative data from key project stakeholders, including staff from MCC and MCA-Malawi, EGENCO plant operators and managers, grant program staff, and board members of the environmental trust. In Table III.2, we present our sampling approach and sample size for each respondent type and indicate the evaluations in which we used the data in our analysis. In addition to interviewing stakeholders, our data collection included site visits to the Kapichira power plant and Liwonde barrage for direct observation.

**Table III.2. Sampling plan for key informant interviews by respondent type**

| Respondent type | Activity evaluations | Number of people | Sample description |
|---|---|---|---|
| MCC DC staff and consultants | All | 5 (with one joint interview) | Staff and consultants who supported the Malawi compact. |
| MCC Malawi-based staff | All | 2 (joint interview) | Managerial staff who oversaw compact implementation. |
| MCA-Malawi monitoring and evaluation staff | All | 2 (joint interview) | Staff from the MCA-Malawi monitoring and evaluation team. |
| MCA-Malawi sector staff | All | 4 | Relevant sector staff for the WSM, grant facility, and trust activities. |
| EGENCO headquarters staff | WSM | 2 | Senior staff at EGENCO headquarters in Blantyre who were heavily involved in the WSM activity and worked closely with MCA-Malawi and MCC. |
| EGENCO operational staff | WSM | 4 (2 per site) | Operational staff at the Kapichira power plant and the Liwonde barrage, including senior site managers and head engineers who had been involved in the procurement and operation of WSM equipment. |

| Respondent type | Activity evaluations | Number of people | Sample description |
|---|---|---|---|
| Trust board members | Environmental trust | 4 | Active committee members, including the committee president, who represent various key sectors for the trust (such as civil society, government, and power companies). |
| Grant program staff | Grant facility | 23 (~2 per grantee)[a] | Staff who implemented activities and managed the grant with MCA-Malawi, including one member of senior management who directed the grant activities and one staff member who oversaw SGEF activities. We identified respondents by soliciting information from each grant organization and reviewing the grant contact list provided by MCA-Malawi. |

[a]For CCJP, we interviewed a third grant staff member because he had further information on activity performance.

For key informant interviews, we developed semi-structured interview protocols for each respondent type and mapped the protocols to the evaluation's research questions. We designed the interviews to elicit participants' perceptions of activity implementation, outputs and outcomes, and prospects for sustaining those outcomes. For instance, for each activity, we asked about actual and planned implementation, the reasons for any deviations from planned implementation, and the successes and challenges associated with implementation. We also asked questions specific to each activity evaluation. For example, for the WSM activity evaluation, we talked about how EGENCO conducted WSM before procurement of the new equipment and about the maintenance and repair plans for the new equipment. For the grant facility evaluation, we discussed the process for grant selection and renewal, perceptions of programmatic and financial oversight of the grants, and the rationale for establishing a grant facility. For the evaluation of the environmental trust, we focused on successes and challenges associated with establishing a sustainable funding mechanism, a functioning board of directors, and other operational and administrative processes.

Mathematica staff interviewed trust board members and MCA-Malawi, EGENCO, and MCC staff between May and November 2018. Kadale Consultants, a data collection firm based in Lilongwe, Malawi, conducted interviews with grant program staff during June and July 2018. Mathematica provided training, oversight, and regular support to Kadale's experienced four-member qualitative survey team. All interviews were conducted in English, audio-recorded, and transcribed for analysis.

### 2. Quantitative and administrative data collection

We also collected administrative data from EGENCO and the Blantyre and Southern Region water boards for use in our evaluation of the WSM activity. In addition, MCA-Malawi and MCC provided a wealth of activity documentation, reports, and monitoring data that we used in each activity's evaluation. For our geospatial analysis of grant activities, we collected GPS coordinates of each intervention village, along with several georeferenced layers of mapping streams, priority areas for reforestation activities, and slope. In Table III.3, we describe the quantitative and administrative data we collected and how we used the data in the evaluation.

**Table III.3. Description of quantitative and administrative data sources**

| Data source (evaluation) | Description |
|---|---|
| EGENCO | Longitudinal data on weed and sediment management and electricity generation by power plant and at the Liwonde barrage |
| Blantyre and Southern Region water boards | Longitudinal data on water turbidity at three sites along the Shire River |
| MCC and MCA-Malawi | Grant indicator tracking table; grant facility manual, policy guidelines, resource requirements, call for proposals, and communications plan; grant selection criteria; grant proposals and quarterly and final reports; internal and consultant grant evaluations; Upper and Middle Shire environmental assessment reports |
| MCC and MCA-Malawi | Trust feasibility study; trust strategic plan, monitoring and evaluation plan, funding proposal; trust board meeting minutes; implementer deliverables |
| **Geospatial data** | |
| Mathematica | GPS coordinates for the 648 villages in which ENRM and SGEF grants were implemented[a] |
| HydroSHEDS (Lehner et al. 2008) | Vector data representing the geographic location of all streams throughout the Shire River Basin |
| Global Extent of Rivers and Streams data (Allen and Pavelsky 2018) | Vector data of Shire River |
| National Forest Restoration Opportunity areas (Malawi Ministry of Natural Resources, Energy and Mining 2017) | Mapping of forest restoration opportunity areas throughout Malawi, as identified through the National Forest Landscape Restoration Assessment |
| Shuttle Radar Topography Mission (SRTM) slope (Farr et al. 2007) | Digital elevation model with one arc-second (~ 30 meters) spatial resolution |

[a]Coordinates are based on the location of the village chief's house.

## 3. Analysis approach

To address our research questions, we used a variety of methods to analyze data for each performance evaluation. Below, we describe these methods and how we applied them to the research questions on activity implementation, outputs and outcomes, and sustainability. In Table III.4, we summarize the analytic methods we employed for each activity performance evaluation.

**Table III.4. Performance evaluation analytic methods by evaluation activity**

| Analytic methods | WSM activity | Grant facility activity | Environmental trust | Overall ENRM project |
|---|---|---|---|---|
| Implementation effectiveness framework | X | X | X | X |
| Data triangulation | X | X | X | X |
| Thematic framing | X | X | X | |
| Descriptive trends analysis | X | | | |
| Geospatial analysis | | X | | |
| Document review | X | X | X | X |
| Sustainability framework | X | | X | |
| Cross-evaluation data synthesis | | | | X |
| Logic model assessment | | | | X |

**Activity implementation.** To understand and characterize how well each activity was implemented, we employed an *implementation effectiveness framework* in which we classified implementation barriers and facilitators into three categories: (1) intervention design characteristics; (2) implementation process characteristics; and (3) environmental factors exogenous to the intervention. By classifying these barriers/facilitators, we identified the critical factors that affected activity implementation. Use of a common framework allowed us to compare across activities to assess common barriers to and facilitators of the overall project by using *cross-evaluation data synthesis.* With this method, we integrate implementation findings from each activity-level evaluation to present an aggregated analysis of the overall project. Throughout these analyses, we employed *data triangulation* to assess consistency and discrepancies in findings among several data sources such as key informant interviews, activity documentation, monitoring and administrative data, and direct observations. Such a process facilitates the confirmation of patterns or findings and the identification of important discrepancies. For example, when analyzing implementation barriers and facilitators for the environmental trust, we triangulated among interview data with MCA-Malawi and MCC staff, trust board members, and implementing staff, as well as with trust documents and board meeting notes. We used a similar framework to assess other elements of activity implementation, such as grant facility oversight (under the grant facility activity evaluation), whereby we examined barriers to and facilitators of programmatic and financial grant oversight.

**Activity outputs and outcomes.** To assess whether each activity achieved its intended outputs and outcomes, we employed a variety of analytic methods tailored to each research question. To examine how weed and sediment management and water quality are changing over time (WSM activity evaluation), we conducted a *descriptive trends analysis* of data provided by EGENCO, the Blantyre Water Board, and the Southern Region Water Board. We examined seasonal and monthly fluctuations under EGENCO's weed management program in Liwonde, the turbidity of water at three points along the Shire, and power generation by power plant. To assess whether grant activities aligned with recommendations from the baseline environmental assessment

reports (grant facility evaluation), we conducted a *geospatial analysis* to assess how the location of grant activities related to key environmental features such as proximity to steep slopes, forests, and streams.

To assess whether the grant facility achieved its intended outcomes, we also employed *data triangulation* by cross-checking grant monitoring data, grant reports, internal MCA-Malawi grant evaluations, and stakeholder interviews. As part of the analysis, we conducted *thematic framing* to uncover patterns, themes, and issues in the qualitative data in order to identify common and conflicting viewpoints across interviews and data sources. Kadale coded its interviews with grant program staff in NVivo based on specifications provided by the Mathematica team. Data were coded first by topic and then by specific themes and sub-themes within each topic. A Mathematica researcher conducted most of the other interviews so it was not necessary to conduct extensive coding in NVivo, but we applied the same analytical principals to the data. We used thematic framing to assess perceptions about grant facility oversight, maintenance plans for the WSM equipment, and operational successes and challenges of the environmental trust, particularly the process to establish a funding mechanism. For other output and outcome research questions, we conducted an extensive *document review.* For instance, to examine how MCA-Malawi selected applications for grants, we conducted an assessment of detailed documentation on the grant selection process, including evaluation criteria, grant proposals, and sections of the grant facility manual. We also cross-checked findings with interview data from MCA-Malawi, MCC, and grant program staff. We conducted a similar document review to analyze early outputs from the environmental trust. To examine overall activity outputs and outcomes, we *assessed the logic model* against a synthesis of activity-level findings.

**Activity sustainability.** To evaluate the prospects for sustainability of each activity, we used a *sustainability framework* to code responses from interviews with activity implementers, stakeholders, and MCA-Malawi and MCC staff to identify barriers to or facilitators of a common set of sustainability dimensions. We examined stakeholder commitment to the activity's objectives, resource availability and institutional capacity to maintain activity outcomes, and political support for continuing to achieve activity outcomes. As with the assessment of activity implementation, we used data triangulation to cross-check results among several data sources.

All quotes cited in this report are coded by type of interview along with a unique number in order to aid confirmability of the research, a criterion of validity in qualitative research.[5]

## B. Shire River Basin modeling

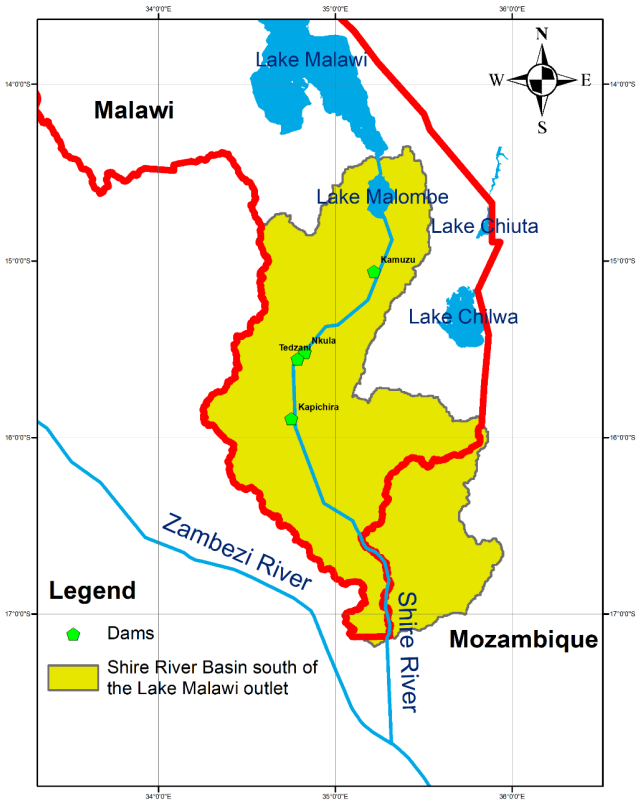
By design, the ENRM and SGEF grants implemented under the grant facility in Malawi lacked the scale to produce a measurable effect on hydropower generation. To assess how scaling up similar interventions across the entire Shire River Basin would affect soil erosion, sedimentation and hydropower generation, we used the Soil and Water Assessment Tool (SWAT), a

[5] The following quote codes are used: MCC = MCC staff or consultant; MCA = MCA-Malawi staff; IP = implementation partner; GS = grant program staff; CL = community leader; GE = government employee; BM = Shire BEST board member; ES = EGENCO staff.

hydrological transport model. Using the SWAT model, we estimated the effects of such interventions at scale by modeling changes in sediment yields throughout the Shire River Basin based on different scenarios for adoption of land management practices and climate change, and identify the savings in reservoir storage and hydroelectric production capacity.

Our evaluation examined changes in land use practices throughout the Shire River Basin over two time frames. First, we used *remote sensing analysis* of satellite-derived imagery of the region to assess the location and quantify the amount of area that has undergone changes in land cover type from the start of ENRM grant activities to the most current date available. Second, we conducted simulations by using the *Soil and Water Assessment Tool (SWAT)*, a hydrological simulation model that incorporates various scenarios of future land use and climate patterns. The simulations forecast—in comparison with current levels—soil erosion and sedimentation rates and their associated, predicted changes in hydropower production capacity. Below, we detail both parts of the analysis as it focuses on the Shire River Basin area inside Malawi, which in Figure III.1 is marked as the yellow area within the national boundaries indicated in red.[6]

**Figure III.1. Shire River Basin boundaries south of the Lake Malawi outlet**




Note: Study area demarcates the boundary of the Shire River Basin, which encompasses area in Malawi and Mozambique, based on HydroSHEDS stream network data (Lehner et al. 2008).

[6] To maintain the integrity of the drainage network within the river basin, the hydrological model included the drainage area as it extends into Mozambique. All subsequent graphical and tabular results pertain only to the drainage area within Malawi.

## 1. Remote sensing analysis

We used remote sensing imagery to estimate land cover change (LCC) in Malawi's Shire River Basin south of the Lake Malawi outlet, comparing values before and after the start of the ENRM interventions, thereby answering our research question on assessing land cover change along the Shire River during the ENRM project. Instead of exclusively focusing on land cover dynamics observed in ENRM project villages, this analysis provides a broad contextualization of basin-wide environmental change. We use estimated historical rates of land cover change in our subsequent analysis to assess the effect that scaling-up SLM practices would have on sedimentation rates and hydropower capacity.

Satellite imagery captures reflected and emitted radiation from objects on the earth's surface whose "emission signatures" may be used to identify an object. For example, vegetation is observably different from the built environment because of its intense emission of wavelengths in the near-infrared band. Given that satellites collect information on reflectance from a wide range of wavelengths in the visible and nonvisible spectra, a substantial volume of data is available for identifying a wide range of surface features. The remote sensing analysis uses the Moderate Resolution Imaging Spectroradiometer (MODIS) Land Cover Type Product (MCD12Q1), produced by NASA. Every year, the product generates a global land cover map at 500-meter spatial resolution (Friedl et al. 2019). We used data from 2015 through 2017, as data for 2018 were not yet available. The global maps are produced by using a random forest classifier on reflectance data acquired by MODIS satellites, with output data available according to several land classification schemes. We selected the International Geosphere-Biosphere Programme (IGBP) scheme, the most commonly used among earth systems scientists, which categorizes pixels into one of 17 land cover types.[7] To make the analysis more manageable, we further reclassified these types into nine biomes: forest, shrublands, grasslands, croplands, wetlands, water, snow, bare, and urban.[8] In Table III.5, we provide a brief overview of the key characteristics of each biome.

**Table III.5. Overview of biome types used in remote sensing analysis**

| Biome | Defining characteristics |
|---|---|
| Forest | Woody vegetation with height greater than two meters and covering at least 60 percent of land area. Forest trees divided into three categories (i) deciduous broadleaf—broadleaf trees that shed leaves in annual cycles; (ii) deciduous needleleaf—same as deciduous broadleaf but with narrow leaves; (iii) evergreen broadleaf— broadleaf trees that retain green foliage throughout the year; and (iv) needleleaf evergreen such as evergreen broadleaf but with narrow leaves. |
| Shrublands | Vegetation with mainly shrubs or short trees (shrubs) shorter than two meters in height. Canopy of shrublands is fairly open and allows grasses and other short plants to grow between the shrubs. |
| Grasslands | Lands with herbaceous types of cover. Tree and shrub cover is less than 10 percent. |
| Croplands | Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and several cropping systems). Note that perennial woody crops are classified as forest or shrubland. |

[7] Appendix Table A.1 presents the original IGBP scheme and matches each IGBP class to the aggregate class used in this analysis.

[8] Snow was not present in the geographic area of interest for our analysis and is therefore not discussed further.

| Biome | Defining characteristics |
|---|---|
| Wetlands | Lands with a permanent mix of water and herbaceous or woody vegetation. The vegetation may be present in salt, brackish, or fresh water. |
| Water | Oceans, seas, lakes, reservoirs, and rivers— either fresh or salt-water bodies. |
| Snow | Lands under snow/ice cover throughout the year. |
| Bare | Barren or sparsely vegetated (bare soil and rocks). Lands with exposed soil, sand, or rocks, with less than 10 percent vegetated cover throughout the year. |
| Urban | Land covered by buildings and other man-made structures. |

Note: Biomes listed here are aggregates of the larger number of biomes appearing in the IGBP land cover classification scheme. The IGBP specifies the defining characteristics of each biome.

Source: Compiled by authors.

We combined georeferenced data for the geographic boundaries of the Shire River Basin within Malawi with data on slope and the basin's stream network. We used these latter two sources in a hotspot analysis, where we focused on land cover changes in areas with the highest risks of soil erosion. Using the 30-meter resolution Shuttle Radar Topography Mission (SRTM) digital elevation model (Farr et al. 2007), we derived surface slope and identified areas with slopes exceeding 20 percent that are deemed unsuitable for cultivation. We also used the HydroSHEDS river network data (Lehner et al. 2008) and constructed 15-meter buffers along all water bodies in the basin. These riverbanks as well as the steep slopes reflect the Ministry of Agriculture, Irrigation and Water Development's recommendation for priority areas for restoration. Establishing these protective buffers through active reforestation or natural regeneration would increase soil stability and decrease erosion and sedimentation (Malawi Ministry of Natural Resources, Energy and Mining 2017).

In our analysis, we computed the total basin area that underwent a change in land class type from 2015 through 2017. We evaluated the changes by both magnitude (for example, the total number of hectares) and type (for example, from wetlands to urban or from cropland to forest). We repeated the analysis with a focus on the hotspot areas that have high slopes or are adjacent to water bodies. We used the most current values to construct a land use baseline, from which we derived the total amount of land that must be restored in order to achieve GoM policy goals.

## 2. SWAT model

To estimate the effects on soil erosion and sedimentation resulting from expanded ENRM activities in the Shire River Basin area under study, we used a hydrological transport model, in conjunction with land cover data collected for our remote sensing analysis. We undertook this modeling exercise to answer our research question on simulating the effects of expanded project activities throughout the area on sedimentation in the Shire River and the related effects on hydropower production. We developed "Business as Usual" scenarios (BAU) to approximate future land cover outcomes based on land cover change trends estimated in the remote sensing analysis. These BAU scenarios serve as counterfactuals for what sedimentation rates would be expected in the absence of any policy change promoting SLM. We used the Soil and Water Assessment Tool (SWAT), which is a continuous, physically based river basin model with a daily simulation time step (Arnold et al. 1998). It provides an integrated framework for

simulating hydrologic, water quality, and agricultural production processes and represents the spatiotemporal variability of these processes. The SWAT model has found extensive application in watershed studies in a variety of regions and countries (Gassman et al. 2007). In addition to estimating changes in soil erosion and sediment production rates on land, we report in this study on variations in siltation rates in the Nkula, Tedzani, and Kapichira dam reservoirs, as indicators of how changes in land use and land management can affect hydropower productivity.

### a. Data sources

We calibrated the SWAT model in order to tailor it to the specific features of the Shire River Basin. The calibration involved a multistage process that required several input data sources. In the first stage, we used elevation data from the HydroSHEDS digital elevation model (Lehner et al. 2008) to partition the basin's watershed into several sub-basins. Next, we defined hydrologic response units (HRU) within each sub-basin to account for heterogeneity in land use, soil type, and land management practices. For example, sub-basins with a combination of shrubland, cropland, and forest would encompass several HRUs to reflect the variation in sediment loading rates associated with each land cover type. We derived the land cover data used by this study from the MODIS Land Cover Type Product described earlier. Forest, shrublands, grassland, and cropland are the dominant land cover types throughout the Shire River Basin and account for 98.6 percent of the basin's area. We combined land cover data with data on soil characteristics, such as clay percentage and organic carbon content, which we obtained from ISRIC-World Soil Information at one-kilometer resolution (Leenaars 2013; Hengl et al. 2015).

Weather data are an essential input to all hydrological models and drive the SWAT simulation. We used daily precipitation data from the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS 2.0) data set produced at the University of California Santa Barbara (Funk et al. 2015). We obtained other weather variables needed to run the SWAT model, such as maximum and minimum temperature, solar radiation, relative humidity, and wind speed, all at daily resolution from the Global Weather Data for SWAT portal (Fuka et al. 2013) and generated from the National Centers for Environmental Prediction Climate Forecast System Reanalysis (NCEP CFSR) product. In Table III.6, we summarize the input data sets for the SWAT model simulation.

**Table III.6. Input data used in SWAT Shire-Malawi model simulations**

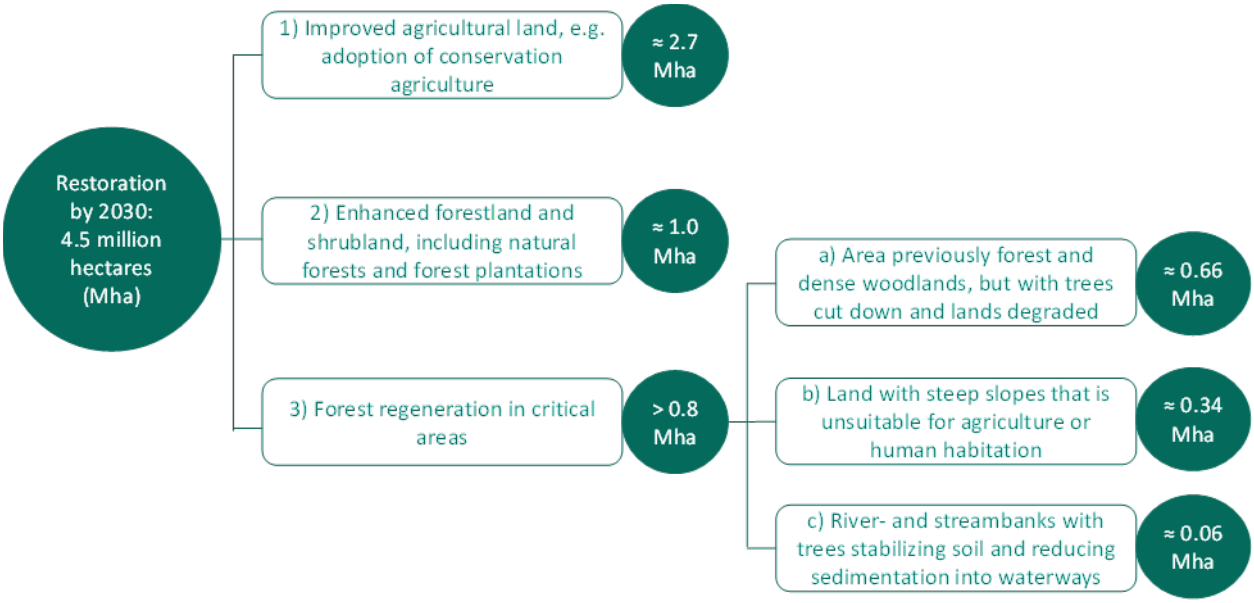
| Data type | Key variables | Source | Spatial resolution |
|---|---|---|---|
| Topography | Elevation (meters above sea level) | HydroSHEDS | 3 arc-second (~90 meter) |
| Topography | Land cover and land use | MODIS | 30 meter |
| Soil characteristics | Soil texture, organic carbon content, bulk density | ISRIC-World Soil Information | 1 kilometer |
| Weather | Precipitation | CHIRPS | 0.05° (~6 kilometers) |
| Weather | Temperature, relative humidity, solar radiation, and wind speed | Global Weather Data for SWAT | ~38 kilometers |

Note: HydroSHEDS = Hydrological data and maps based on SHuttle Elevation Derivatives at multiple Scales; MODIS = Moderate Resolution Imaging Spectroradiometer; ISRIC = International Soil Reference and Information Centre; CHIRPS = Climate Hazards Group InfraRed Precipitation with Station data.

## b. Analysis overview

After calibrating the model against observed sediment inflow rates for the Nkula, Tedzani, and Kapichira reservoirs (FICHTNER 2014), we used the SWAT model to generate forecasts of future soil erosion and associated sedimentation rates by using two families of scenarios: (1) business as usual (BAU), in which no sedimentation interventions are implemented such that observed LCC trends continue, and (2) "policy" scenarios in which GoM's policies and strategies achieve sustainable natural resource management, namely, the restoration of 4.5 million hectares of degraded land by 2030 (Malawi Ministry of Natural Resources, Energy and Mining [MNREM] 2017a).[9] We applied the same rules developed by MNREM to identify priority areas for land restoration activities, but we focused only on areas within the Shire River Basin. In Figure III.2, we describe the components of the country-wide policy target by land type.[10] Improving existing agricultural land is the primary means of land restoration, and the combination of efforts designed both to enhance existing forestland and shrubland and regenerate forests in critical areas comprises the remainder of the means of restoration. Implementing GoM's plans would restore 802,581 hectares of land in the Shire River Basin.

**Figure III.2. Land restoration activities comprised in the "policy" scenario**




Note: Authors' calculations based on MNREM (2017b).

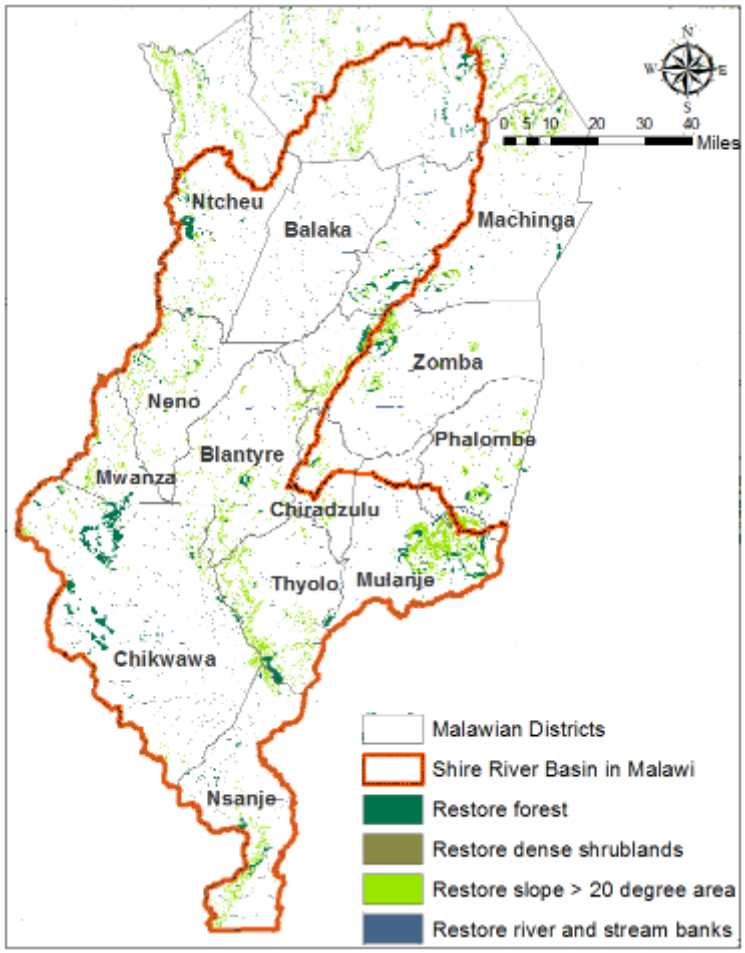
[9] We extrapolated land use projections for BAU 2030 and BAU 2050 to their respective years by using annual average historical biome transition rates that were estimated over the period 2010 through 2017. Given that the SWAT model runs at the sub-basin level, we summed land use areas by biome type for each sub-basin.

[10] MNREM (2017b) asserts a countrywide restoration target of 4.5 million hectares (Mha), but does not provide subtotals by restoration activity. Our calculations from adopting the methods and guidance offered in that report lead to an estimate of 1.06 Mha of total forest regeneration in critical areas, exceeding the 0.8 Mha target. By our estimates, the restoration policy scenario could lead to 4.7 Mha of restoration by 2030, exceeding the publicly declared target of 4.5 Mha.

(continued)

Our policy scenario projects to 2030 the characteristics of what the land cover composition of the Shire River Basin would need to be in order to achieve GoM objectives. The scenario incorporates these measures for croplands, degraded forestlands, and other high-priority lands, with a focus on steep slopes and river banks.[11] The spatial distribution of such changes is shown in Figure III.3. The SWAT model also specifies assumptions about farmers' cropland management practices, for which, to the best of our knowledge, no database covering Shire River Basin farmers is available. We therefore used household responses to the World Bank's 2017 Living Standard Measurement Survey (LSMS) to estimate district-level adoption rates of soil erosion control practices, which we assign to their constituent sub-basins. In Appendix B.2, we provide further information about this procedure.

**Figure III.3. Biome restoration activities incorporated into the "policy" scenarios**




Note: These areas reflect the high-priority areas identified by MNREM (2017).

The "policy" scenario is targeted for 2030 and will therefore require many years for full realization. Over that time frame, climate change–induced shifts in temperature and/or precipitation may mean that historical weather data are a poor guide to the conditions that the Shire River Basin will experience in the future. As a result, we selected two climate change scenarios from an analysis of 35 regional climate models (RCM) in order to proxy for two possible future climatic states. We drew our "modest climate change scenario" from a model that uses the Representative Concentration Pathway 2.6 (RCP 2.6) emissions trajectory, which simulates a world in which the global economy has mitigated much of its greenhouse gas emissions by 2100 but experiences continued warming. Our second scenario approximates a "severe climate change scenario" based on RCP 8.5, a trajectory in which limited mitigation has been achieved with the majority of energy demand generated from fossil fuel

[11] We note that MNREM (2017b) estimates 36,478 hectares of river- and streambank restoration opportunity area throughout Malawi, which is about 24,000 fewer hectares than our estimate. The discrepancy likely reflects differences in the hydrological data sets used to determine the location and extent of rivers and streams.

combustion (van Vuuren et al. 2011). As the precipitation impacts of climate change will largely depend on total cumulative emissions, the two scenarios depict a plausible range of future precipitation outcomes. In Appendix B.3, we provide a complete description of the climate model selection process.

Our analysis combined the BAU and policy scenarios, per the RCP 2.6 and RCP 8.5 climate models, to generate six projections of soil erosion and associated sedimentation and related effects on the basin's capacity to produce hydroelectricity. We present the six projections in Table III.7. We compare each scenario to the baseline case, which we modeled by using historical land cover and weather data. We then present our results as percentage differences against the baseline case.

**Table III.7. SWAT model scenarios**

| Land use change scenario | Climate scenario(s) | Time frame |
|---|---|---|
| Baseline | Historical | Historical |
| BAU | Historical | 2030 |
| Policy | Historical | 2030 |
| BAU | RCP 2.6<br>RCP 8.5 | 2050 |
| Policy | RCP 2.6<br>RCP 8.5 | 2050 |

BAU = Business as Usual; RCP = Representative Concentration Pathway. RCP 2.6 refers to the "modest climate change" scenario while RCP 8.5 is a "severe climate change" scenario.

# IV. FINDINGS FROM THE WEED AND SEDIMENT MANAGEMENT ACTIVITY EVALUATION

**Summary of key findings**

### Trends in WSM

- Land use management practices in the Shire River Basin before the activity was implemented caused significant changes to the watershed environment—most notably, rapid acceleration of sedimentation and growth in aquatic weeds.
- Water turbidity near the Nkula power station has been steadily increasing each rainy season over the past dozen years, and is much higher there than it is upstream during the rainy season because sediment travels and concentrates downstream.
- Before the ENRM project, EGENCO did not have the resources to effectively address the impact of weeds and sediment on hydropower production.
- The increase in weed growth and sedimentation rates has led to lost hours because power plants periodically shut down operations to address low water levels and weeds and silt clogging the turbines.

### Implementation

- The WSM activity was designed to procure equipment that would dredge sediment and remove weeds and to train EGENCO staff on the procured equipment to generate hydropower more efficiently.
- Equipment delivery was significantly delayed because the contractor selected by MCA-Malawi had poor performance, which also led to dropping the plan to procure a dredger for Nkula. By the end of the compact, the weed removal equipment was delivered. The dredger at Kapichira was delivered but not in use as the sediment disposal area was still being built.
- EGENCO proved to be a supportive partner in implementing the activity, and was engaged and invested in equipment procurement and training.

### Sustainability

- EGENCO and the GoM have committed funds to ensure the completion of Kapichira's sediment disposal area, but there are still substantial risks that could keep EGENCO from achieving its capital dredging plan for Kapichira and properly disposing of the dredged sediments.

The Weed and Sediment Management (WSM) activity involves procuring and training EGENCO staff on mechanical equipment to help EGENCO remove excess sediment and weeds at key sites in the Shire River that are inhibiting the generation of hydroelectric power. Since the equipment were not operational at the time the compact ended (and when data were collected for this report), we are unable to assess how the equipment affected weed and sediment management. In this interim evaluation, we analyze trends in the effects of excessive weed growth and sedimentation to provide a baseline, contextual understanding of the cyclical problems of weed and sediment in the Shire River Basin. The interim evaluation also examines the implementation process for the WSM activity, and prospects for EGENCO's sustained capacity to run and maintain the equipment. In our final evaluation report, we will seek to measure the performance of WSM equipment and any resulting changes in power plant operations and generation.[12] We analyzed data from interviews with key stakeholders, site observations, EGENCO administrative data on WSM management, and water quality data from

[12] The final evaluation report will provide more information on the activity's sustainability.

the Blantyre and Southern Region Water Boards. Our analysis answers the following research questions about the WSM activity:

1. How was the activity implemented?
   a. Was the activity implemented as planned? Why or why not?
   b. Which implementation factors supported or hindered the effectiveness of the activity?
2. How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity?
3. What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity?

## A. Weed and sediment growth and management before the activity was finished

### 1. Background on weed and sediment growth

**Environmental assessments have identified specific practices that have increased soil runoff into the Shire River.** Over the past 25 years, land management practices in the Shire River Basin in Malawi have resulted in significant changes to the watershed environment—most notably, large increases in sedimentation and aquatic weed growth. The specific practices that led to increased soil runoff include massive tree-cutting, burning residues and grasses when preparing land, making improper farming ridges, and cultivating on steep slopes or close to riverbanks without proper soil control measures (LTS International et al. 2010). Soil runoff into the Shire provided more nutrients for aquatic weeds such as water hyacinth and elephant grass, which bloomed in the changing environment.

**Increased population density, poverty, and traditional gender roles exacerbated many of these problems.** Agriculture is the mainstay of Malawian employment, and as population density increased, farmers used more marginal, less productive land to grow crops, such as forests and steep slopes (LTS International et al. 2010). In addition, impoverished households practiced farming that was not environmentally sustainable, cut down trees to produce charcoal, or practiced other inadvisable activities to maximize much-needed income in the short term (LTS International et al. 2014c). Because of social norms on gender roles and intra-household dynamics, women have more trouble than men accessing agricultural inputs, and women are less empowered in agricultural decision making. Even though land inheritance is traditionally matrilineal in the upper and middle Shire River Basin, male family members often make operational decisions on land and asset management, which can lead to more extractive land uses such as collecting large amounts of firewood and making charcoal. Women also have more limited opportunities to learn and use sustainable land use practices than men do (LTS International et al. 2014c). These socioeconomic dynamics can lead to further soil erosion and lower hydropower plant yields.

EGENCO staff who have been working in the Shire River Basin for many years echo many of the findings of the environmental assessment. They also cite changing climate patterns as a contributing factor to increased soil runoff and weed growth. With more varied rainfall patterns,

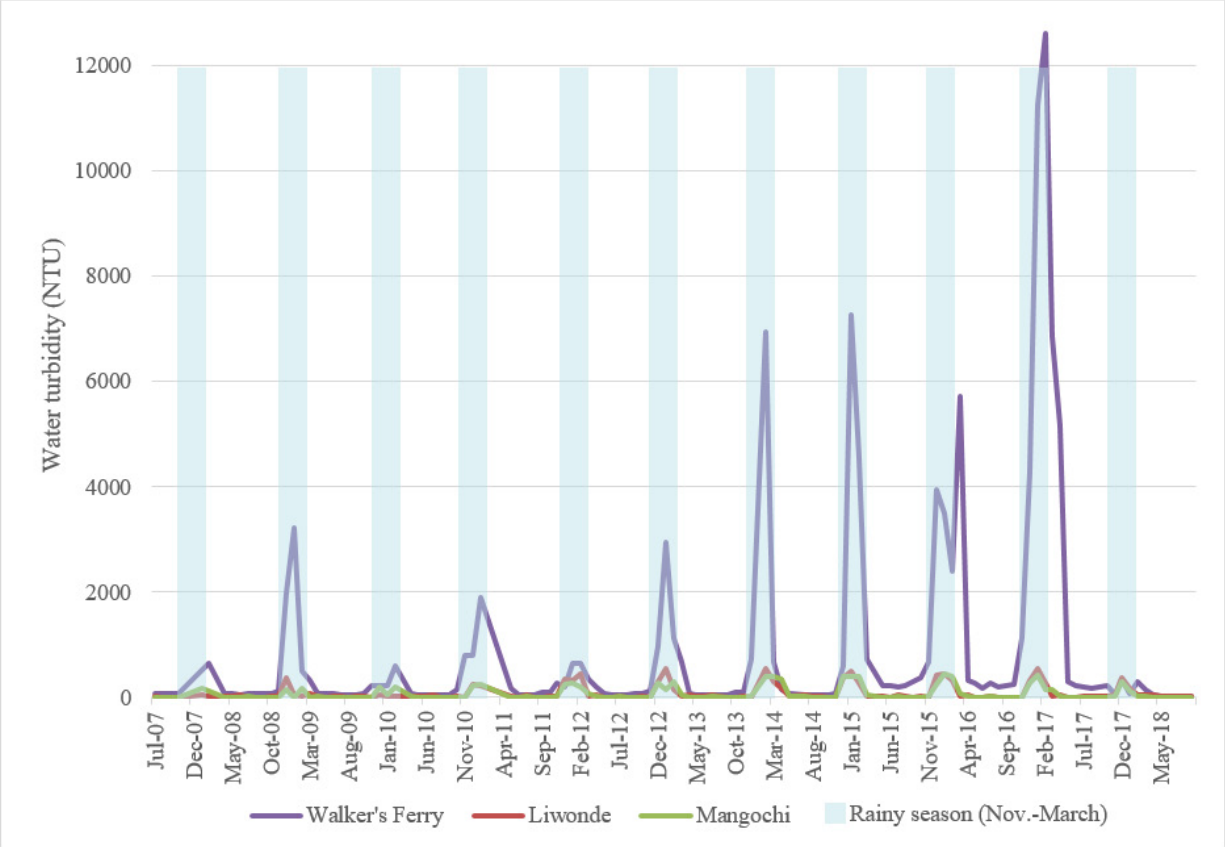
households become more desperate to find fertile farming land, and even farm in and along the banks of rivers, contributing even more nutrients to the river to exacerbate the weed problem.

**The increasing sedimentation rates and weed growth in the Shire River are interfering with hydropower generation.** Hydropower plants require high enough water levels and flow free of substantial debris in order to operate efficiently and continuously. They use adjacent head ponds to regulate the water flow necessary to generate power. However, those head ponds are affected by upstream water use and land management. Sediments and weeds float downstream, building up in concentration until they reach each power plant site. At that point, the sediments settle in the head ponds, reducing the amount of water available for generating power, which impacts the power plant's utilization rates. The floating weeds clog the intake screens, and removing them is a difficult and expensive process that necessitates shutting down the generation turbines. Figure IV.1 shows how weeds can clog the water intake screen at the Nkula power station.

**Figure IV.1. Intake screen with weeds (Nkula power station)**

**Water turbidity data support EGENCO's reports of increased sedimentation in the Shire River, particularly for downstream users**. Water turbidity measures the clarity of water and can be a proxy measure for sedimentation. The higher the measure of water turbidity, the more sediment in the water. An analysis of data from the Blantyre Water Board and Southern Region Water Board reveals that turbidity spikes during the rainy season, when faster water flow can increase soil runoff and also dredge up more silt from the bottom of the river (Figure IV.2). We also note that turbidity has been steadily increasing each rainy season over the past dozen years, implying that land management practices along the Shire River are degrading water quality. Water turbidity (and thus sedimentation) is also much worse downstream than it is upstream. Turbidity readings from Liwonde and Mangochi in the Upper Shire show a pattern of increased turbidity during the rainy seasons, spiking at 413 NTUs (Nephelometric Turbidity Units) in Mangochi and at 540 NTUs in Liwonde. Further downstream at Nkula, water turbidity readings were exponentially higher, cresting at over 12,000 NTUs in February 2017. In other words, prior to WSM activity completion, upstream sediment runoff is creating even more problems for downstream water users as sediment travels downstream and concentrates near the Nkula power station.

**Figure IV.2. Shire River water turbidity: monthly, 2007–2018 (prior to WSM activity completion)**




Source: Blantyre Water Board and Southern Region Water Board.

Note: Water quality was measured at the Walker's Ferry water station, near the Nkula power plant head pond and at the Shire River in Liwonde and Mangochi townships. Reported results are monthly averages. NTU = Nephelometric Turbidity Units.

## 2. WSM before the compact activity finished

To maximize the hydroelectric power it can generate, EGENCO has had to find creative solutions to sedimentation and weeds. EGENCO operates three power stations along the Shire River that account for almost all the grid power produced in Malawi: Nkula, Tedzani, and Kapichira. It also manages a barrage in Liwonde upstream of the power plants that regulates water flow between the upper and middle Shire. We turn now to the state of WSM before the compact activity finished, beginning with the furthest point upstream in the Shire River, the Liwonde barrage, before moving downstream to each power plant. Figure I.2 in Chapter I shows the location of the power stations and barrage in Malawi.

**Liwonde barrage.** The Electricity Supply Corporation of Malawi (ESCOM, before the company unbundled and EGENCO was formed**)** tried to address the weed situation by removing the weeds before they reached the power stations. Beginning in the early 2000s, EGENCO staff at the Liwonde barrage, upstream of all three power plants, saw a significant increase in floating weeds (such as hyacinth and uprooted elephant grass) during the rainy season. Initially, staff closed the

barrage that regulated water flow downstream and then used a grab crane to remove weeds that had collected at the barrage. This hurt downstream water users, however, and it was time-consuming to remove the weeds. EGENCO then received support from the Malawian army to remove weeds upstream before they floated downstream, but this still failed to solve the problem.

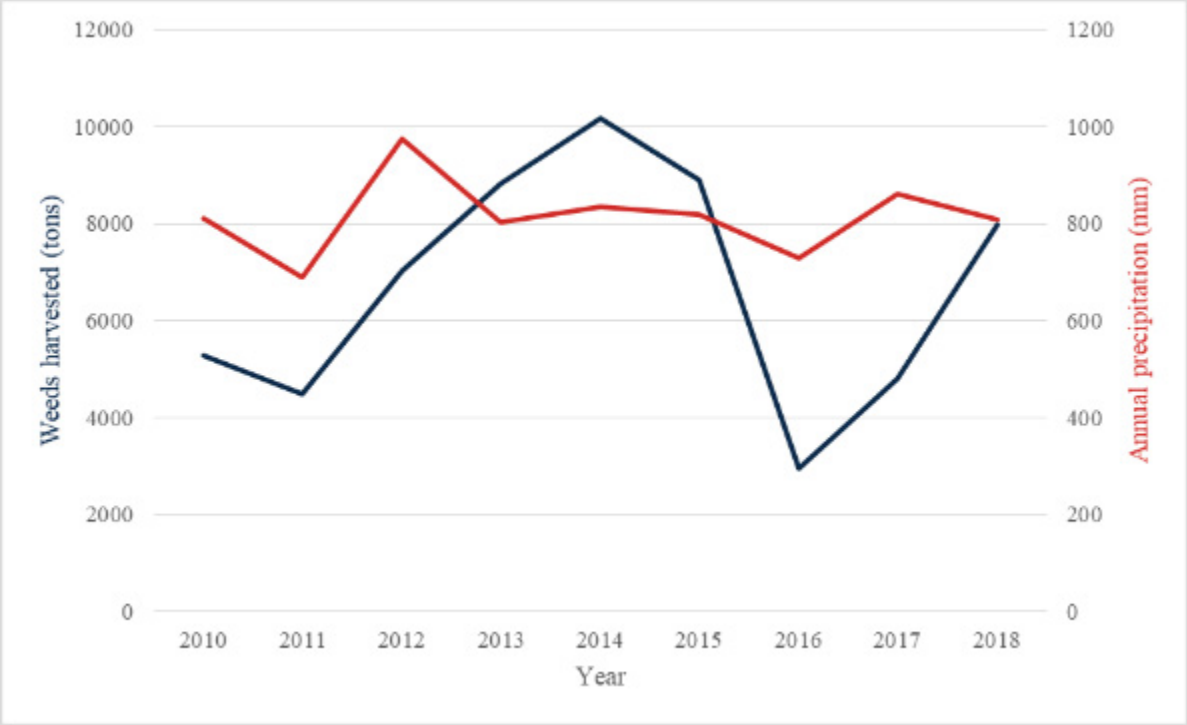
**Figure IV.3. Weed harvestors and conveyor belt procured under the WSM activity (Liwonde barrage)**

In 2005, ESCOM was able to procure more sophisticated equipment to remove the weeds, namely a weed cutter, a weed harvester, and a conveyor belt. It also placed a boom across the river to catch weeds before they reached the barrage. The weed cutter chops the weeds so they can be removed before they float downstream during a rainstorm. The weed harvester scoops up all the loose weeds (including the ones chopped by the weed cutter) at the boom. The harvester loads these weeds into a boat and then brings them to the side of the river, where a conveyer belt is used to unload the weeds onto the shore. (Figure IV.3 shows the weed harvester and conveyer belt purchased for the WSM activity, similar to the one ESCOM procured in 2005.) With this equipment, EGENCO could remove the weeds at the boom while maintaining water flow at the barrage.

During heavy rains, the weight of the weeds overwhelmed the boom enough for it to collapse twice. In more recent years, the weed removal equipment has broken down frequently and taken a long time to repair. At the same time, the amount of weeds floating downstream has reportedly increased. EGENCO reports that it has generally been harvesting more weeds each year from 2011 through 2018, with the exceptions of 2016 and 2017 (Figure IV.4). It is possible that equipment breakdown limited the amount of weeds that could be harvested in 2016 and 2017. As shown in the figure, it is unlikely that the weed harvesting dip in these years was caused by changes in precipitation, shown in red, which has been a more or less consistent 800 mm

annually from 2013 through 2018. We reached out to EGENCO for more information, and can revisit this in future evaluation reports.

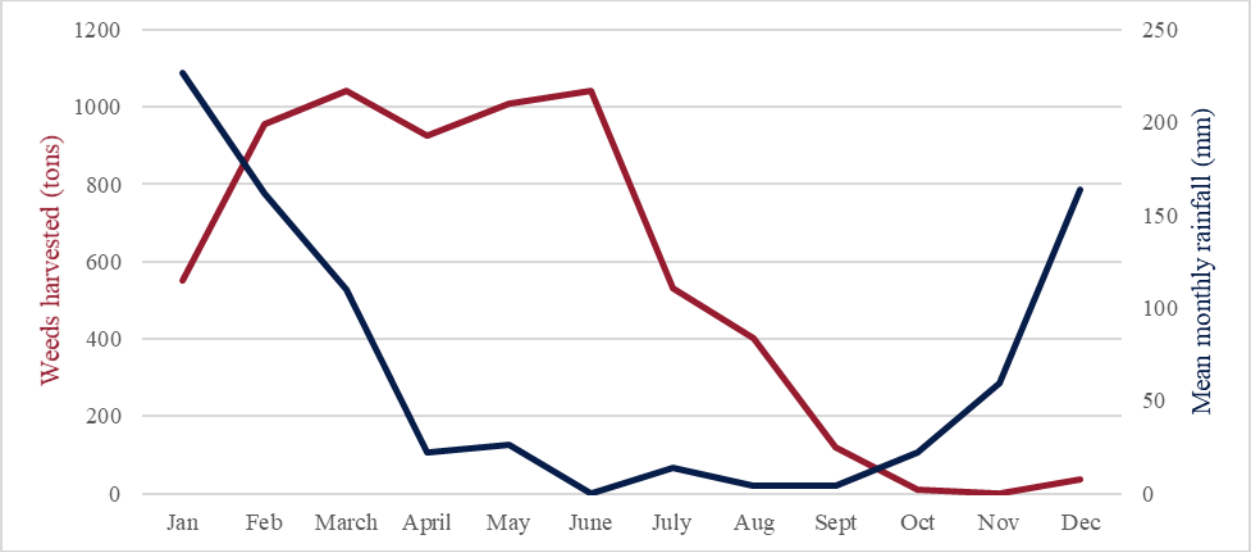
**Figure IV.4. Tons of weeds harvested annually and total precipitation, 2010–2018 (Liwonde barrage)**




Source: EGENCO and authors' calculations using CHIRPS precipitation data (Funk et al. 2015)
Note: Figures for 2018 only include data from January through September.

Upstream from the barrage is Liwonde National Park. EGENCO would like to cut down and remove weed beds in the river during the dry season as a preventative measure. However, the Park has prohibited this because it can destroy animal habitats. Therefore, EGENCO focuses its weed removal toward the end of the rainy season, which lasts from December through February (as shown in red in Figure IV.5). Rising water levels in that season, along with faster currents, naturally uproot weeds and pull them downstream, and there is a build-up of weeds flowing to the head pond for several months during and following the rainy season. As the figure illustrates in blue, weed removal peaks, on average, from February to June each year. The World Bank is currently funding construction of a new boom near the barrage to more effectively capture the growing number of floating weeds. However, just removing the weeds at the Liwonde barrage was not enough to reverse the negative effects on power generation.

**Figure IV.5. Average tons of weeds harvested by month and mean monthly precipitation, 2010–2018, (Liwonde barrage)**




Source: Authors' calculation from EGENCO data and CHIRPS precipitation data (Funk et al. 2015).
Note: Data from 2018 only include weeds harvested from January through September.

**Nkula power plant.** The nearest downstream power plant from the barrage is Nkula, which has an installed capacity of 124 megawatts. In addition to weeds, excessive sediment flowing in the Shire reduces the water level in the head ponds at the power stations. The power stations need a high enough water level to be able to generate at capacity. To remove sediment that over the years has accumulated into a landmass in the middle of the head pond, Nkula got a dredger in 1998 and received a more modern one from the Government of Japan in 2015 (Figure IV.6). EGENCO has used these dredgers to do a focused removal of sediment, but the dredgers have only a limited capacity to remove sediment, and the work has not been able to meet EGENCO's needs for power generation.

**Tedzani power station.** About 7 kilometers downstream from Nkula is the Tedzani power station (Figure I.2), with an installed capacity of 92.7 megawatts. Sediment and weeds at Tedzani are directly affected by WSM at Nkula. The dredging at Nkula removes sediment that would have also floated down the Shire to Tedzani. Tedzani does not have any of its own sediment removal equipment. It has contracted with companies on an ad hoc basis to dredge sediment from the head pond as resources allow, but it has relied mainly on the dredging at Nkula to limit the head pond sedimentation at Tedzani.

**Figure IV.6. Island of sediment and weeds and old dredging equipment at Nkula head pond**

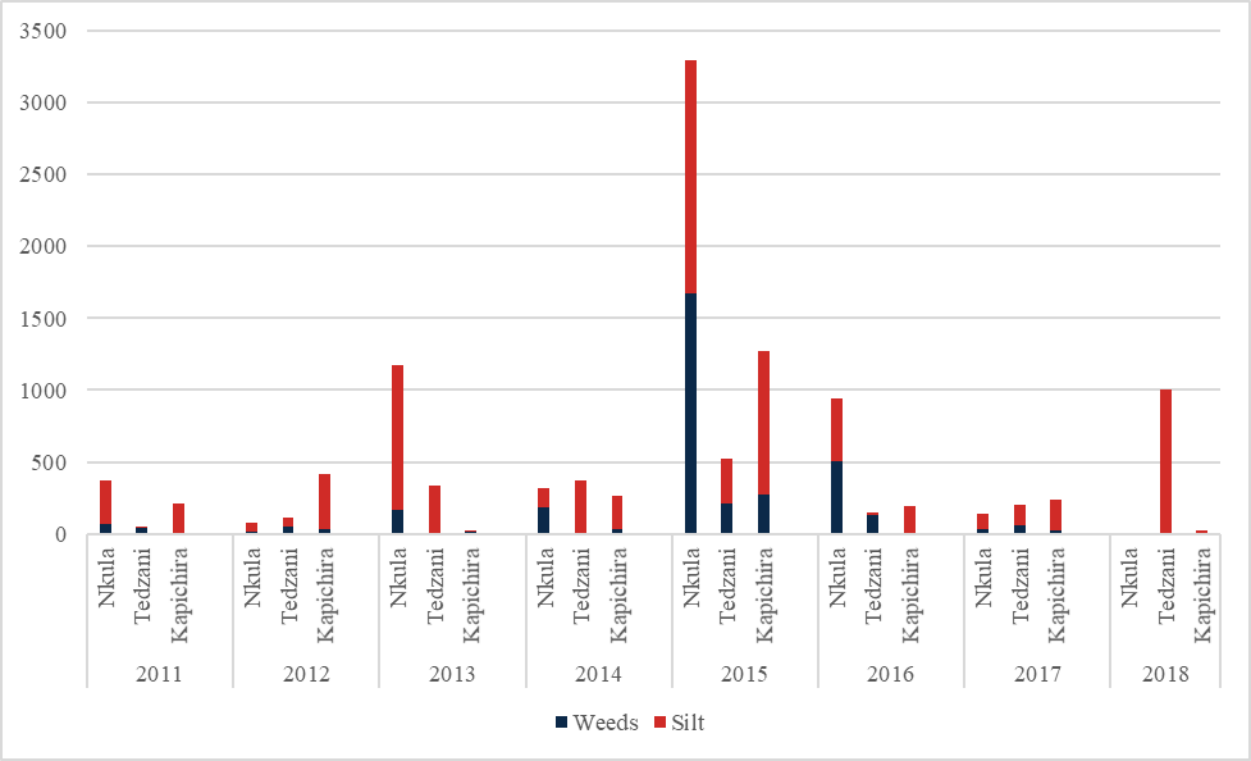
**Kapichira power station.** Further downstream, south of Blantyre and adjacent to the Majete Wildlife Sanctuary, is the Kapichira power station. Kapichira is the highest capacity power station in Malawi with an installed capacity of 129.6 megawatts. Like Tedzani, it did not have any of its own sediment removal equipment. To remove sediment, it conducted a process called scouring. EGENCO would shut down plant generation for the day and then open the floodgates to flush out sediment in the head pond. According to EGENCO staff, this was only partially effective, and did not come without cost. Beyond having to shut down the power plant when doing the scouring and keeping it shut down until the water in the head pond builds back up to an acceptable level, the process also carries serious environmental consequences. Scouring can change downstream habitats and cause fish to get stuck in the mud. Although EGENCO used to scour monthly, since 2016 the water levels have been too low for this process to be effective. The result has been a significant buildup in sedimentation in the head pond, severely limiting power generation. EGENCO notes that around 70 percent of the head pond has been lost to sedimentation, with only about 2,715,000 $m^3$ of storage capacity remaining out of a head pond area of 9,050,000 $m^3$ (EGENCO 2018).

### 3. Effects of sediment runoff and weed growth on power generation

The accelerating sediment runoff and weed growth in the Shire, and the lack of resources for EGENCO to combat the problem at its hydroelectric plants and key areas upstream, have substantial consequences for power generation. As sediment fills the head ponds at power stations, the low water levels mean EGENCO is unable to generate electricity at capacity. Weeds, debris, and silt that float downstream also clog the plant turbines, requiring the station to be turned off for cleaning and repair. Figure IV.7 shows the number of hours of power generation that EGENCO reports it has lost due to weeds and silt by power station. The outages ebb and flow depending on weather patterns, including heavy rains during the rainy season that

accelerate the river's flow and bring heavy sediment and weeds downstream. The dry season also affects power generation because the water levels go down, and this limits the number of hours a hydropower plant can operate. This problem existed both before and during the Malawi compact.[13]

**Figure IV.7. Hours of power generation lost to weeds and silt, by power plant (2011–2018)**




Source: Authors' calculation from EGENCO data.

Note: Figure shows the number of hours that power stations at Nkula, Tedzani, and Kapichira were unable to generate power as a result of excessive weeds and sedimentation, as tracked by EGENCO.

## B. Implementing the WSM activity

In this section, we address research question #1 on activity implementation. For the WSM activity, MCC originally planned to procure the following:

- **Liwonde barrage:** One harvester, two tipper trucks, and a conveyor belt to remove weeds collected at the boom in Liwonde and bring them to a dumping site away from the river. MCC also planned to fund the rehabilitation of the older weed harvester that was currently in use.

[13] We received and analyzed preliminary data from EGENCO, and we are waiting for EGENCO to clarify how it defines and collects some of its measures, and to give us data on the hours when there is no generation and the amount of energy that is not produced because of weeds and silt. There will be a more detailed trends analysis of those measures in the final report.

- **Nkula:** (1) a dredger to remove built-up sedimentation in the head pond and to maintain necessary water levels, and (2) a trash barrier to collect floating debris before it clogs the water intake screens
- **Tedzani:** No equipment. Tedzani is only 7 km downstream from Nkula, and sediment dredging and debris removal at Nkula was intended to benefit Tedzani as well.
- **Kapichira:** A dredger to address the same sedimentation problems that Nkula had

The procurement process ended up taking much longer than expected. Ultimately, the equipment for Liwonde was successfully procured, delivered, and transferred to EGENCO. Rehabilitating the older harvester ended up being cost-prohibitive, so MCA-Malawi purchased a second harvester instead. MCA-Malawi had immense challenges, though, in procuring the dredger equipment for Nkula and Kapichira. MCA-Malawi finally had to cancel its original contract for the dredgers for nonperformance; after delays and cost issues, it was only able to procure a dredger for Kapichira (Figure IV.8). It took a long time to unlock funding tied to the original contractor and procurement had to be completed by the end of the compact. With some of the money saved from canceling the Nkula dredger, MCA-Malawi was able to also procure two backhoes and two tipper trucks for Kapichira. For Liwonde, MCA-Malawi decided to procure a second weed harvester because it was more cost effective than rehabilitating an existing one.

**Figure IV.8. Newly procured dredging equipment (Kapichira power station)**


Table IV.1 summarizes WSM management plans before and after the compact, comparing what was planned to what actually took place. The WSM activity ended up upgrading equipment at the Liwonde barrage and the Kapichira power station. The Nkula and Tedzani power stations did not reap any benefits from the WSM activity.

**Table IV.1. WSM management plans before and after compact**

| EGENCO location | Pre-compact | Post-compact (planned) | Post-compact (actual) |
|---|---|---|---|
| Liwonde barrage | • Degraded weed removal equipment (weed harvester and cutter, conveyor belt) | • Upgraded weed removal equipment (1 weed harvester, rehabilitate 1 weed harvester, 2 tipper trucks, 1 conveyor belt) | • Upgraded weed removal equipment (2 weed harvesters, 2 tipper trucks, 1 conveyor belt) |
| Nkula power station | • Limited-capacity dredger (from Japan's aid agency) | • High-capacity dredger from MCC<br>• Trash barrier | • Limited capacity dredger (from Japan's aid agency)<br>• Limited trash barriers at the intake for weeds |
| Tedzani power station | • Ad hoc contractual dredging | • Ad hoc contractual dredging | • Ad hoc contractual dredging |
| Kapichira power station | • Inefficient scouring | • High-capacity dredger and sediment removal system | • High-capacity dredger and sediment removal system (including 2 backhoes and 2 tipper trucks) |

To critically assess the implementation of the WSM activity, we employ an implementation effectiveness framework in which we classify implementation facilitators and barriers as characteristics of the intervention design, characteristics of the implementation process, and stakeholder and environmental factors. We examine whether the WSM activity was implemented in compliance with the planned specification, schedule, and budget. Overall, even though MCC and MCA-Malawi identified the correct technical approach to address immediate weed and sedimentation issues, particularly by focusing on dredging at the head ponds, the planned activity was delayed and ultimately only partially implemented because of MCA-Malawi and MCC's inexperience in dealing with dredger contractors and MCA-Malawi's limited capacity to oversee contract management. Table IV.2 summarizes our findings from this analysis.

**Table IV.2. WSM implementation effectiveness framework**

| Category | Facilitators | Barriers |
|---|---|---|
| Intervention design characteristics | • Responsive to power generation problem<br>• Largest funding amount of ENRM project activities | • Combined procurement for dredger and harvesters<br>• Limited experience with dredger procurement |
| Implementation process characteristics | • Flexibility in activity design<br>• Supportive implementing partner in EGENCO (capacity, engagement)<br>• Simple process to procure harvesters | • MCA-Malawi capacity for contract management/oversight<br>• Sunk costs for canceling contracts<br>• 5-year compact clock<br>• Specialization of dredger procurement |
| Stakeholder and environmental factors | • GoM resources for WSM post-compact | • Economic headwinds for EGENCO<br>• Unbundling from ESCOM |

### 1. Characteristics of the intervention design

**The WSM activity was appropriately designed to immediately address a pressing challenge for hydropower generation in Malawi**—excessive sediment and weeds inhibiting the operation of power plants. MCC and MCA-Malawi worked closely with ESCOM (at the time of compact development before the unbundling that created EGENCO) to identify the most effective equipment needed at each power plant site. Because Nkula and Tedzani are close to each other, stakeholders agreed that focusing on dredging at Nkula would also benefit Tedzani downstream (given budget constraints). MCC staff also emphasized the importance of dredging at Kapichira, the highest capacity power station in Malawi, which had only 30 percent of its head pond volume remaining. For the barrage at Liwonde, stakeholders identified the need for upgraded equipment to effectively remove weeds. This equipment would complement the work of a World Bank project that is building a new boom and barrage. At the same time, MCC staff expected the weed removal equipment to have a more limited discernible effect on plant utilization than dredging at the head ponds would.

Although the activity did not get at the underlying cause of the issue, it was responsive to the problem by identifying an approach that could produce an immediate effect, particularly for sediment dredging. The compact underscored the importance of this activity by allocating a greater share of ENRM project resources to it. Of the three ENRM project activities, the WSM activity received 57 percent of project funds. The activity was also seen as "low-hanging fruit" by some members of the MCC team: a relatively straightforward activity in which the only thing holding back success was the money to procure the right equipment. Unfortunately, this optimism was not borne out in practice.

**MCC and MCA-Malawi staff were unfamiliar with the process of procuring dredger equipment.** MCC had never supported the procurement of dredgers like this before, and staff did not realize at first how specialized the task was, and that only a handful of companies in the world can effectively manufacture dredgers for Malawi's specific needs. As one MCC staff member put it, "I think everyone underestimated how complex [the procurement process] would be" (MCC_6). A key early error on the part of MCA-Malawi was bundling the procurement for the dredger and the weed harvesters. MCC advised against this, but MCA-Malawi preferred having just one contractor to oversee on the WSM equipment. Companies that manufacturer harvesters are different than the ones that manufacturer dredgers, so the only bidders on a bundled procurement are vendors that then subcontract the procurement to different manufacturers. The decision to bundle the procurements had significant repercussions for the implementation.

### 2. Characteristics of the implementation process

**The contractor selected by MCA-Malawi performed poorly on the original procurement of the WSM equipment.** The contractor had expertise in sediment management, but knew very little about dredgers. The contractor was also severely behind its deliverable schedule: the equipment was originally supposed to be delivered by Year 3 of the compact. MCC later found out that the contractor was in financial straits (and was ultimately bought out by another company). The contractor eventually admitted it would be unable to deliver the dredgers until

after the compact end date, which was an unworkable solution under an MCC compact. The contractor was able to deliver on the harvesting equipment for the barrage before the compact ended, although still later than the initial deadline. MCA-Malawi ended up canceling the dredging portion of the contract and re-bidding it out to a dredging manufacturer.

**A key barrier to project implementation was MCA-Malawi's inability to manage and oversee large procurement contracts.** It is a laborious task to oversee international contractors, made more so when specialized equipment is involved. It took MCA-Malawi over a year to realize the extent of the contractor's poor performance. At that point, there was a large sunk cost to canceling the contract because so much time and money was already spent, and the compact had a non-negotiable, five-year length. MCA-Malawi ultimately decided it needed to cancel the contract in order to salvage procurement of some of the planned equipment. After MCA-Malawi canceled the contract, funding for the equipment was tied up in an ongoing legal dispute with the contractor. This forced MCA-Malawi to only include one dredger in the re-bid procurement. This entire process entailed a substantial amount of time and energy on MCA-Malawi's (and MCC's) part—a significant opportunity cost that caused other parts of the ENRM project, such as the environmental trust (Chapter VII) to receive less attention than they needed.

In the end, **MCA-Malawi and MCC were able to salvage key components of the WSM activity because of their organizational flexibility and support from EGENCO.** MCA-Malawi decided to prioritize obtaining a dredger for Kapichira. Nkula already had a working dredger, though it provided only limited sedimentation relief in the head pond. In contrast, Kapichira had no dredging capability while also having the largest power capacity of any plant. EGENCO staff estimated that up to 70 percent of the Kapichira head pond was filled with silt, and the plant regularly ran at only 50 percent of capacity. MCA-Malawi realized that there was huge potential to unlock gains in power generation if Kapichira had the right equipment. MCA-Malawi learned from its earlier contracting experience, and this time it contracted directly with a dredger manufacturer. It had to compromise on the specifications in order for the dredger to arrive in time. For instance, instead of having the electric motors that EGENCO preferred, the dredger had diesel engines, which required fuel (an extra cost) and were not ideal from a noise and pollution standpoint, because the head pond abuts the Majete Wildlife Refuge, and many animals, including crocodiles and elephants, use it as a watering hole.

**EGENCO's capacity and engagement in the WSM activity facilitated equipment delivery.** Although the dredger was delivered to EGENCO before the close of the compact, significant work remained after the compact to finalize all of the tasks related to the dredger. This work was transferred over to the GoM and coordinated with EGENCO. Throughout, MCC and MCA-Malawi staff reported that EGENCO was a willing partner able to see the task through to completion, although it took some time for EGENCO to become fully engaged in the activity. This included paying for an additional staff member to attend training in the United States to operate the dredger, because the compact only paid for training two staff members. We also find some evidence that EGENCO has started to invest more in weed management at the Liwonde barrage. Although weed management costs were relatively flat (adjusted for inflation) from 2010 through 2016, there was a spike in resources devoted to weed management for the first nine months of 2017, from around MWK 200 million in 2016 to over MWK 300 million in 2017, or

from roughly $418,000 to $627,000 using current exchange rates (EGENCO-reported figures). It is unclear if this change is related to MCC investment in the energy sector as part of the compact, a one-time blip, or a serious new commitment to tackling the weed problem. We reached out to EGENCO to gain a better understanding of changes in weed management costs, and plan additional analysis on this in the final evaluation report.

**One challenging implementation factor for Kapichira was finalizing arrangements for the sediment disposal area.** Once the sediments are dredged from the head pond, they have to be removed in a sustainable and environmentally friendly way. EGENCO's plan was to lay down a pipeline that would carry the sediment to two different locations depending on the season. During the rainy season, EGENCO would send the sediment through the pipeline and then dump it in the river downstream. The fast-moving currents would distribute the sediment throughout the river, eventually making their way to the Indian Ocean. During the dry season, the pipeline would carry sediment to a large disposal area (see Figure IV.9 for a picture of the disposal site under construction). A pipe at the bottom of the disposal area would drain water from the sediment back into the Shire as the sediment dried. EGENCO reported that a government environmental assessment supported this approach to sediment removal for both the rainy and dry season. EGENCO is considering providing the dry sediment to farmers or fertilizer companies because the soil is rich in nutrients. Originally, EGENCO was supposed to be responsible for developing and building the disposal system. It later asked MCA-Malawi to pay for this, arguing that it did not have enough money after the unbundling with ESCOM. Although MCC did eventually agree to fund the building of the disposal area, this task was not completed by the close of the compact, and the financial responsibility for it was shifted to the GoM.

**Figure IV.9. Sediment disposal area under construction: Kapichira power station, November 2018**

In addition to the inability to provide a dredger for Nkula, there was also a failed procurement for the **trash barrier at Nkula.** EGENCO staff advocated for the barrier because so many trees were going into the intake screens during floods, causing significant damage to the screens and forcing the power plant to shut down to fix the problem. However, the initial design of the trash barrier did not seem to be a viable solution, and there were no bids from contractors. MCC staff believe there was too much risk for contractors in a firm, fixed-price contract for a product that was not clearly specified. MCA-Malawi reallocated funds from the trash barrier to the Kapichira dredger and associated equipment, which was critical because other funds were tied up in litigation with the original dredger contractor. However, the results of these procurement changes meant that Nkula did not receive any of the critical equipment to deal with weeds and sediment that it was hoping to obtain under the compact. (The compact did support the installation of small trash barriers at the in-take for weeds at Nkula, a much more limited intervention than initially planned).

In contrast with Nkula and Kapichira, the Liwonde barrage's procurement of **weed harvesters, tipper trucks, and a conveyor belt was successful and went relatively smoothly**. One reason is that the equipment is simpler and more straightforward to procure. Second, EGENCO had older harvesters that it used to develop specifications for the new equipment. EGENCO requested upgraded models of the equipment it had received already. Third, the subcontractor that manufactured the harvester equipment was an American company that proceeded with the work even without an advance, believing it would be paid in full by the U.S. government. Although the equipment was delivered later than planned, with EGENCO taking charge of it in May 2018, the contractor completed equipment delivery and training well before the close of the compact.

Overall, procuring WSM equipment was much more complicated and challenging than what MCC and MCA-Malawi planned. The key lessons that emerge from our analysis of equipment procurement under the WSM activity are: (1) conduct separate procurements for equipment that is manufactured by different types of companies; (2) clearly specify the technical components of the equipment at the procurement stage; and (3) invest in contractor oversight to identify implementation problems early.

### 3. Stakeholder and environmental factors

There were only minor environmental factors that affected the implementation of the WSM activity. One facilitator of implementation were the resources the GoM committed to completing the WSM activity after the compact closed down, particularly those devoted to the Kapichira dredging equipment. During a site visit almost two months after the end of the compact, we witnessed contractors continuing to prepare for the launch of the dredger and digging out the disposal area. GoM resources supported these key tasks so the dredger could eventually become operational.

A barrier to activity implementation was EGENCO's structural changes. During the compact, EGENCO was unbundled from ESCOM to become its own energy generation company. Some EGENCO staff said this created some communication problems with MCA-Malawi as the

specifications for the WSM equipment were being created and activity implementation was underway. Staff changes on both sides resulted in some communication breakdowns. One EGENCO staff member cited the selection of inferior backhoe loaders to remove sediment from the dumping site, instead of higher capacity front-end loaders. The unbundling with ESCOM also created financial challenges for EGENCO. ESCOM had been operating at a loss for years, and with the split, EGENCO took on some of its debt. A lack of financial resources was one contributing factor to consistent under-investment in WSM.

## C. WSM activity sustainability

It is too early to know whether the WSM equipment will be successful in removing the weeds and sediment that are interfering with power plant generation. This section describes how well positioned EGENCO is to finishing the activity and operationalizing the equipment. We use a sustainability framework to assess the facilitators and barriers to sustainability, whether they involve institutional commitment and technical capacity, the availability of financial resources, and political support.

Overall, we find that even though EGENCO has demonstrated strong commitment to the WSM activity by, for example, training more staff to operate equipment and procuring spare parts to repair equipment, it still faces substantial risks to execute its capital dredging strategy as planned. Many things can derail a seemingly straightforward project. For example, EGENCO did not have a fusion machine available to mold the pipes together to carry the dredged sediment to the disposal area. This is a specialized tool that is not available in Malawi and has to be procured separately. Without it, the pipeline cannot be completed. Continued political support will be crucial for EGENCO to address such challenges as it works to operationalize its dredging plan. Table IV.3 summarizes our findings on perceptions of sustainability of the WSM activity.

**Table IV.3. Analysis of WSM sustainability dimensions**

| Dimensions | Facilitators | Barriers |
|---|---|---|
| Institutional commitment and technical capacity | • EGENCO sustainability plan<br>• Trained more staff members | • Risks to dredger operations |
| Availability of financial resources | • Annual maintenance and repair budget<br>• Financial support from GoM | • EGENCO financial challenges |
| Political support | • Strong support from GoM and EGENCO management<br>• MCC plans a second compact in Malawi | • MCC compact has ended |

### 1. Institutional commitment and technical capacity

**EGENCO, as MCA-Malawi and MCC staff have reported, has been a committed partner for the WSM activity.** EGENCO developed a sustainability plan with MCA-Malawi to clearly document how it will ensure the continued operation of the equipment. It has also shown its

commitment by paying to train another staff member on dredger operations and transferring staff from Nkula who were experienced in dredging sediment. If certain parts are missing post-compact—for example, elbow pipes to connect the sediment pipeline and fire extinguishers for operational safety—EGENCO staff have noted that it has a budget to procure them. EGENCO has proved itself as a high-capacity partner and understands the magnitude of the WSM issue.

Yet, there are also **serious risks to the dredger operations**. Stakeholders noted that the capital dredging plan is for the dredger to operate 24 hours a day, 7 days a week for five years in order to complete the dredging necessary just to restore the functionality of the head pond. There is a risk that EGENCO still does not have enough trained staff and funding to support the extent of this dredging and to procure fuel and oil for the dredger. There is a risk that the sediment disposal area could fill up quickly, and EGENCO will not be able to give away the dried soil fast enough and instead just dump sediment downstream. There is also a risk that such sustained dredging could have negative environmental consequences for wildlife at Majete and for downstream users, particularly if sediment is dumped there.

### 2. Available financial resources

**EGENCO has committed to providing additional resources to support the WSM activity**. EGENCO staff report they have an annual maintenance and repair budget to ensure they have both proper spare parts in stock and the money to procure fuel as needed. As EGENCO staff have also reported, including in their activity sustainability plan, EGENCO has already stocked up on spare parts for the equipment at Kapichira and in Liwonde so it can quickly make any repairs that are needed. It also has copies of the operational manuals. Staff noted that they can continue to call on the manufacturer to help troubleshoot mechanical issues and can order additional spare parts through the manufacturer as needed. The GoM has also demonstrated its commitment by continuing funding to the WSM activity post-compact.

Still, EGENCO is facing challenges involved in paying down debt, increasing its billing collection rate, and becoming a financially viable company. It has limited resources to support WSM activities, and its future budget may depend on its financial solvency. Its sustainability plan provides no specific monetary commitment for completing the WSM activity.

### 3. Political support

**The WSM activity has strong political support from EGENCO management and the GoM.** And even though the MCC compact has ended, limiting U.S. government influence on the activity, MCC recently announced that it is planning a second compact in Malawi. The effects of the WSM work are also clearly observable to the population at large. If the dredging is operationalized at Kapichira, that power plant will produce much more electricity, reducing the number of blackouts in the country. It will also be obvious to any outside observer, such as government officials, whether any dredging is being done. This observability will help political stakeholders hold EGENCO accountable for the success of the activity. Political support for the WSM activity is critical because it can influence other dimensions of sustainability, including the availability of additional financial resources and the strength of ENGENCO's institutional commitment.

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# V. FINDINGS FROM THE GRANT FACILITY EVALUATION

**Key findings**

### Grant facility implementation

- The grant facility provided 11 grants to organizations working to improve sustainable land management and address social and gender barriers in the Shire River Basin.
- MCA-Malawi conducted a thorough and detailed process to identify the most qualified grant applicants, but, at times, it relied on subjective criteria and undocumented decisions.
- The grant facility was well designed to allow for experimentation in order to identify effective SLM interventions. However, it was also constrained by a three-year intervention window and cost-reimbursement contracts that slowed some grant implementation.
- Most of the villages selected by grantees were located in or near prioritized areas, based on environmental features identified in the Middle and Upper Shire Baseline Assessments and Action Plan.
- MCA-Malawi was able to conduct rigorous financial and programmatic grant oversight, but, on the programmatic side in particular, MCA-Malawi staff often faced too much work with too few resources, a consequence of the grant facility structure.
- Despite the benefits of and drawbacks to many alternative grant facility structures, MCA could have designed its grant facility to have greater synergies with the planned environmental trust.

### Grant facility objectives[a]

- The grant facility followed the baseline environmental reports' main recommendations on activity type and intervention location when soliciting and approving grant proposals.
- The grant facility exceeded the output targets it tracked, including the number of trees that survived, the number of leaders trained in ENRM, and the number of operational REFLECT circles and VSLs. However, the grant facility did not have the resources, capacity, or a plan to obtain high quality data on key measures such as the number of farmers adopting SLM practices. Many grants also did not cover the entire agricultural value chain.
- The grant facility succeeded in pushing all grantees to integrate ENRM and SGEF activities—a novel approach.
- The grant facility supported activity scale-up and raised awareness about the seriousness of the soil erosion problem by generating evidence on the activity's effectiveness, creating linkages with other donors and government stakeholders, and working to establish an environmental trust. Given that the trust is not yet operational and the compact has closed, it is too early to know whether the grant facility will have lasting effects.

[a] Objectives are defined in the grant facility's policy guidelines document (MCA-Malawi 2014b) and listed in section V.G.1.

MCA-Malawi created a grant facility to address environmental and natural resource management challenges as well as social and gender disparities in the Shire River Basin. MCA-Malawi commissioned baseline environmental assessments of the Upper and Middle Shire River Basins. From those assessments, MCC and MCA-Malawi identified seven Upper Shire subcatchment areas and five Middle Shire subcatchment areas as priority target areas for grant programming and issued a call for proposals for organizations to apply for grants. In this chapter, we analyze implementation of the grant facility, including the grant selection process, use of the baseline environmental assessments, and grant oversight. We also assess the extent to which the grant facility achieved its main objectives.[14] We answer the following research questions:

[14] For our examination of the implementation, outcomes, and sustainability of individual grants, see our interim evaluation's companion report (Velyvis et al. 2019).

1. How was the grant facility activity implemented?
    a. Was the grant selection process guided by clear, fair, and transparent principles, leading to the selection of the most qualified applications? Why or why not? What were those principles?
    b. Was the grant facility implemented as planned? Why or why not?
    c. Which implementation factors supported or hindered the effectiveness of the grant facility?
    d. Did the grant selection process prioritize interventions based on the recommendations of the Middle and Upper Shire Baseline Assessments and Action Plan? Why or why not?
    e. Was grant oversight sufficient according to stakeholders? Why or why not?
    f. Was the decision to establish a grant facility economically and programmatically efficient? What were the alternatives?

2. Which objectives from the grant facility manual were achieved by the grant facility and which were not, and why?
    a. Did the grant facility objectives capture the recommendations in the Upper and Middle Shire baseline reports?

For this analysis, we drew on interviews with MCA-Malawi staff, MCC staff, and program staff at each of the 11 ENRM and SGEF grantees as well as on an extensive review of program documentation from all stages of creation of the grant facility. We begin by examining the grant selection process before assessing grant facility implementation, intervention prioritization, grant facility oversight, the rationale for the grant facility relative to alternative arrangements, and whether the grant facility achieved its objectives.

## A. Grant selection process

We begin our analysis by examining how MCA-Malawi's grant facility selected grant recipients (research question 1a). We examine whether clear, fair, and transparent principles guided the selection process, drawing on interviews with MCA-Malawi, MCC, and grant program staff as well as on detailed documentation provided by MCA-Malawi on the grant facility's selection process. We begin by examining MCA-Malawi's initial outreach and its call for proposals.

MCA-Malawi issued a public call for proposals for ENRM and SGEF activities on January 12, 2015. It advertised the call in print in the main Malawian newspapers and published the call on its website. MCA-Malawi also held regional briefings for NGOs in Blantyre and Mangochi to encourage organizations to apply for grants, answering any questions about the application process. The deadline for proposal submissions was February 23, 2015. At that time, MCA-Malawi received 57 applications from 56 organizations (MCA-Malawi 2015). It is important to note that MCA-Malawi initially planned for a two-stage application process whereby applicants would first submit a proposal concept note. If MCA-Malawi approved the concept, then the applicant would submit a full proposal. Given the delays in setting up and operationalizing the grant facility, MCA-Malawi decided to forgo the concept note stage of the application process

and instead requested full proposals from all applicants. In Table V.1, we summarize the number of grant applications at each stage of the review process, as described in more detail below.

**Table V.1. Number of grant applications by review process stage**

| Application stage | Number of applications |
|---|---|
| Received by submission date | 57 |
| Passed initial screen for required documentation | 42 |
| Reviewed and recommended by technical evaluation committee | 29 |
| Passed applicant verification visits | 17 |
| Approved grant after final budget and contract negotiations | 11 |

Source: MCA-Malawi 2015 and interviews with MCA-Malawi program staff.

After receiving the applications, MCA-Malawi conducted a preliminary screening that found 15 applications ineligible for further review based on their failure to meet proposal requirements for formatting, content, and submission date (MCA-Malawi 2015). MCA-Malawi then established a grants technical evaluation committee to review and score the remaining 42 proposals. The committee comprised three MCA-Malawi staff who oversaw ENRM activities, SGEF activities, and financial grants management. In addition, two consultants with expertise in ENRM or social and gender activities sat on the committee. According to MCA-Malawi staff, each reviewer assessed every proposal, and the committee as a whole agreed on the final proposal score.

Proposals were scored in the areas of organizational capacity, efficiency, methodology, sustainability, impact, social and gender integration, and capitalization of lessons learned. (The complete evaluation score sheet appears in Appendix Table A.2). Each area included between two and nine criteria that were scored separately on the following four-point scale: (1) unsatisfactory, (2) marginal, (3) satisfactory, (4) very satisfactory. The scores for each section's criteria were then averaged to provide one score for each section. Section scores were then averaged across all sections to provide an overall score for the proposal. Under the methodology section, some specific criteria included the following:

- Does the implementation strategy reflect a logical process that would lead to achievement of the outputs/outcomes/objectives?
- Is the logical framework clearly presented, and does it contain all required components (objectives, outputs/outcome, activities, objectively verifiable indicators, and source of information)?
- Do the applicant and partner organizations and staff have the capacity to participate fully in monitoring the intervention?

**The review committee discussed the scoring criteria before evaluating the proposals, but there was no documentation that defined how the scoring categories mapped to each criterion in question.** The score sheet contained many subjective terms that lacked definitions. For instance, under organizational capacity, one criterion was "sufficient relevant technical

expertise and experience in applicant and partner organizations for proposed interventions." There was no definition as to what constituted "sufficient relevant technical expertise" and examples of how it related to a rating of unsatisfactory, marginal, satisfactory, or very satisfactory. Even though the proposal process encouraged organizations to include activities that integrated ENRM and SGEF programming, the process lacked a clearly documented way to score the technical expertise criterion if an organization had technical expertise in one area but not in another. In the absence of clear definitions and documentation, it is probable that the grant review committee did not apply any rating criterion uniformly across all applicants. Even though we initially planned to re-score a selection of grant applications to check for inter-rater reliability, we were unable to do so without further documented guidelines. The committee may have indeed identified the strongest applicants, but it did not use a reproducible process that lent itself to external verification. Appendix Table A.3 provides additional examples of the score sheet criteria that are in need of further definitions to help ensure that reviewers uniformly applied the same standard for each grant application review.

Further, **the evaluation committee decided not to enforce any hard score cut-offs.** The score sheets do note that, for a proposal to be accepted, an application must average at least a satisfactory rating (an average of 3 or higher) for each area of evaluation. However, the evaluation committee decided to relax the cut-off and use more subjective criteria to determine whether to recommend a proposal for approval. Even if a subjective determination might have assisted the committee in identifying the best applicants, no documentation exists as to why applications falling below the predetermined threshold should be exempted from the cut-off. Along with the lack of supporting documentation needed to define each application criterion, the evaluation committee's application ratings appeared arbitrary.

After the evaluation committee made its recommendations, MCA-Malawi conducted a verification exercise through on-site visits and a review of financial controls. One grantee reported that the questions posed by MCA-Malawi about each organization during its verification exercise included the following: "Does it have the capacity? Are [staff] available there? Will their interventions be sustainable? How long have they been there on the ground? The governance, do they have the structure? The board? Staff?" (GS_1). MCA-Malawi staff followed a verification checklist and noted that they conducted some field visits to assess activities currently undergoing implementation and undertook a reference check based on earlier completed projects and financial audits. Seventeen organizations passed the verification stage and earned a recommendation for funding. Throughout the process, MCA-Malawi encouraged organizations to form partnerships if one or the other organization demonstrated certain gaps in technical knowledge or capacity. For instance, MCA-Malawi suggested to two organizations that did not pass the verification stage that they join a consortium of successful applicants. Next, MCA-Malawi conducted budget negotiations with the 17 recommended applicants that passed the verification stage. Given MCA-Malawi's constraints on the funds available to support the grantees and on the number of applicants it could reasonably oversee, MCA-Malawi decided to support 11 of the 17 recommended applicants. For the most part, MCA-Malawi reported that it simply selected the strongest remaining applicants, though without specifying any criteria as to why it selected one over another. In one case, an applicant joined another applicant's consortium. In another case, an applicant became ineligible because of high overhead costs and limited in-

country staff support. Although the selection process seemed lengthy, no stakeholders commented that it took too long to identify the 11 grantees.

The 11 grantees represented a mix of international NGOs with country offices in Malawi (five grantees) and Malawian NGOs (six grantees). Of the Malawian NGOs, one of them is affiliated with a for-profit company (FISD) and one has independent affiliates in other countries (CCJP). Notably, smaller community-based organizations were not selected as grantees, often due to lower capacity. Larger more well-known international NGOs did not apply, reportedly due to the size of the grants and limitations on billing overhead costs. One MCA-Malawi staff member noted that local NGOs bring many benefits to their work, including their understanding of the context and the communities and thus are well placed to begin rapid implementation (MCA_3). The size of the grants and the implementation expectations of the grant facility affected the types of organizations that applied and which ones MCA-Malawi ultimately supported. The grantees tended to represent higher capacity Malawian NGOs or international NGOs with a strong country presence and low overhead costs.

**Overall, MCA-Malawi conducted a thorough and detailed process to identify the most qualified grant applicants.** MCA-Malawi undertook several layers of review that involved the participation of external experts, site visits, and an in-depth check of an organization's financial and technical capacity. MCA-Malawi tried to codify the process by using a score sheet in one stage and a verification checklist in another stage. Still, the many staff involved in the various review processes had to make subjective decisions at times and were unable to document the rationale for their decisions. Indeed, such an approach may have been the only approach given the amount of information that MCA-Malawi reviewed for each applicant, but it makes it impossible to reproduce the scoring process and verify whether MCA-Malawi ultimately selected the most qualified applicants. MCA-Malawi staff and staff from the successful grantees believed that the selection process was fair. They concluded that the process yielded the most qualified candidates, though their perceptions could be biased by their role in the selection process.

## B. Grant facility implementation

Overall, the grant facility underwent implementation as planned with only minor deviations (research question 1b). The grant facility approved three-year grants to 11 organizations and consortia, with grants ranging from about $362,000 to $836,000. The grants were subject to review for renewal after each of the first two years of the three-year implementation period, and MCA-Malawi approved the renewal of all grants at both junctures. In general, each grantee carried out a similar package of overlapping activities that included efforts related to soil and water conservation measures for farming and forestry management, alternative income-generating activities to help households move away from unsustainable land management practices, institutional capacity building for enhanced community-based management, and women's empowerment programming. ENRM grant activities included mulch production, crop diversification, the planting of trees and vetiver grass, the construction of box ridges and contour ridges, and the development of village-level ENRM action plans. Often, these activities were complemented by SGEF activities that included the delivery of training in business skills,

leadership, gender equality, and adult literacy; the organization of community REFLECT circles; and the establishment of VSL groups.

Initially, MCC and MCA-Malawi envisioned that most of the grants would fund either ENRM or SGEF activities, but all grants ultimately supported both ENRM and SGEF activities, thereby providing a more synergistic and holistic intervention approach to the needed interventions. Some grantees had more experience in one area than in another and thus focused more on a certain set of activities. For instance, WOLREC and CCJP had significant experience in conducting SGEF activities, but they also incorporated some ENRM activities into their programming. Conversely, United Purpose and the Foundation for Irrigation and Sustainable Development (FISD) had more experience in conducting ENRM-related activities, as reflected in their grant proposals. Some grantees, with MCA-Malawi's support, added in ENRM or SGEF activities during the course of implementation.

MCA-Malawi, with MCC's support, pushed for certain types of activities based on recommendations from the environmental assessment reports, MCA-Malawi's and MCC's preferences, and the grantees' own experience and technical comparative advantage. MCA-Malawi, with MCC's support, also encouraged grantees to conduct SGEF activities that MCA-Malawi deemed effective, particularly REFLECT circles and VSLs. At the same time, some grantees focused on activities in which they had particular experience, such as establishing a solar irrigation scheme (FISD). Other grantees implemented approaches unique to their organization, such as TSP's clan-based approach.

The grantees covered four of the five priority catchment areas in the Middle Shire and four of the seven priority catchment areas in the Upper Shire. In four catchment areas, two grantees conducted programming in the same priority area (and WOLREC's programming spanned two catchment areas), but the grantees generally worked independently of one another and did not coordinate their activity implementation. MCA-Malawi provided overall technical support by, for example, organizing quarterly meetings with all the grantees to discuss common challenges and distribute materials on interventions such as REFLECT circles and VSLs. MCA-Malawi staff also conducted technical and financial oversight visits to the grantees and commissioned a consultant to conduct an annual grants' evaluation.

In Appendix Table A.1, we provide summary information on the implementing organization, activities, and location of each of the 11 grantees.

## C. Facilitators of and barriers to grant facility implementation

To conduct a critical analysis of grant facility implementation, we used an implementation effectiveness framework in which we classified implementation facilitators and barriers as intervention design characteristics, implementation process characteristics, and environmental factors (research question 1c). We examined whether the grant facility was implemented as planned and what implementation factors supported or hindered activity implementation. Overall, we found that the grant facility was able to identify experienced grantees that understood the local context. The grantees were able to collaborate successfully with local

leaders and government officials on activity implementation. Stakeholder interviews and monitoring data provided evidence that grants generally achieved their intended outputs and were well received within the intervention areas. However, the establishment and oversight of a grant facility posed substantial challenges for MCA-Malawi. Given the available resources and capacity, staff struggled to monitor grant outputs and outcomes effectively. Further, MCA-Malawi had to make a trade-off between implementation of a short-term grant facility and its efforts to establish a sustainable environmental trust. In Table V.2, we summarize our findings from the analysis of grant facility implementation.

**Table V.2. Grant facility implementation effectiveness framework**

| Implementation frame | Facilitators | Barriers |
|---|---|---|
| Intervention design characteristics | • Well-sequenced grant facility evolution<br>• Allowed for program experimentation to test different intervention approaches<br>• Solicited wide range of grant proposals | • Three-year grant time frame<br>• Reimbursement-structured contracts |
| Implementation process characteristics | • Identified experienced grantees that understood the local context<br>• Grantees leveraged their experience<br>• Strong collaboration with district government officials<br>• Flexibility to adjust grant programming based on programmatic needs | • Limited monitoring resources for MCA-Malawi<br>• Conflicting oversight roles<br>• Limited monitoring capacity among grants<br>• Unable to measure activity effectiveness in preventing erosion |
| Environmental factors | • Consistent donor economic environment<br>• Depreciation of Malawian Kwacha during grant implementation | • Drought during Year 1 of grant implementation |

## 1. Intervention design characteristics

The grant facility exhibited important design characteristics that facilitated successful activity implementation. First, **the grant facility set-up was aligned with the overall project logic and was responsive to the baseline environmental assessments.** MCA-Malawi commissioned detailed environmental assessments for the Upper and Middle Shire River Basins, including assessments of social and gender issues. MCA-Malawi used the results of the assessments to guide development of the grant facility manual and the call for proposals, including the eligible type and location of grant-funded activities. In addition, MCA-Malawi designed the grant facility to address the root causes of inefficient hydropower generation, namely, poverty among communities in the Shire River Basin as manifested by a lack of decision-making power and leadership opportunities for women and by poor land management practices. The grant facility addressed these issues holistically by funding a range of interventions for each targeted community.

Further, **the grant facility's structure supported some activity experimentation with the objective of identifying effective activities in reducing sedimentation and weeds in the Shire River Basin.** As part of the grant facility's call for proposals, MCA-Malawi provided prospective applicants with its grant manual, which listed priority activities and catchment areas

eligible for funding. It also took a unique approach in asking for the integration of social and gender activities within sustainable land management planning. Within the listed priority activities, the grantees could propose various intervention approaches or activity combinations. Even though activities and approaches were similar across many grants, some important differences were evident. For instance, some grants focused on different components of the agricultural value-chain, including irrigation, livestock, and markets. Other grants focused more heavily on alternative income-generating activities for the community, such as beekeeping and the cultivation of fruit trees. WOLREC, for instance, was unique in targeting legal aid to women. Other grantees implemented their activities differently, with TSP working through the traditional clan structure. Unfortunately, the grantees and MCA-Malawi struggled to collect high quality monitoring data on activity implementation, thereby limiting the grant facility's evidence base on activity effectiveness.

**The design of the grant facility also created two barriers to activity implementation**. By the time of the grant awards in August 2015, the grant facility had to operate on a short timeline. First, the grant facility incurred large opportunity costs occasioned by setting up the facility and soliciting, reviewing, and approving grants and then disbursing funds and monitoring and evaluating grant activities. Second, the grantees had only three years to conduct their activities before the compact closed in September 2018. Some of the activities focused on longer-term changes such as development of a tree nursery or the promotion of gender equality. Thus, longer-term changes supported by the grants were hard to measure and assess during the short implementation period. Several grant staff noted the limitations of the three-year time frame. Some grantees needed several months to a year just to begin activity implementation (GS_2). In addition, the reimbursement structure of the grant contracts delayed some project activities and led to financial problems for some grantees. MCA-Malawi reimbursed grantees for costs after implementation of their activities. Cash flow among Malawian nonprofits is limited, and the lack of sufficient seed money to conduct activities made it difficult for several organizations to implement activities on schedule.

### 2. Implementation process characteristics

**MCA-Malawi benefited from its ability to identify experienced organizations that understood the local context in the Upper and Middle Shire River Basins.** Given that the grant selection process was robust and thorough, MCA-Malawi was able to support relatively strong organizations, as demonstrated by grantee performance and interview data. (Section A above provides details on the grantee selection process.) As a further benefit, many grantees were already operating in the area assigned to them under the ENRM project. They had worked with communities in their assigned areas and had already conducted similar types of land management and/or social and gender enhancement programs. Further, all grantees reported that they collaborated with district government officials, paving the way for smoother activity implementation. Activities were aligned with government policy and provided continuity with similar activities implemented before award of the grants.

An important feature that facilitated activity implementation was **MCA-Malawi's flexibility with grantees to adjust their programming based on community needs and early results.**

Many grantees emphasized MCA-Malawi's flexibility as essential to activity success. As one grant staff member summarized, "[MCA-Malawi was] able to accommodate some of the emerging demands from the communities. They were allowing the budget to be able to meet those aspirations within the project life span" (GS_3). For example, CICOD was able to reprogram some of its budget to dig boreholes to assist in creating its tree nursery. It was also able to procure cement, which was a key community priority emerging from the REFLECT circle activity.

On the other hand, **both MCA-Malawi and the grant staff faced implementation challenges.** The MCA-Malawi grant facility team consisted of three core staff members in addition to an ENRM project manager and a two-member monitoring and evaluation team with responsibility for all aspects of the compact. The core staff was responsible for overseeing 11 grants covering a wide geographic area. At times, core staff members were unable to provide needed support, such as providing feedback on grantee quarterly reports in a timely manner and conducting regular site visits to each grantee. One MCA-Malawi staff member noted that the team needed better internal coordination to work more efficiently to manage the grants with the available resources (MCA_2). At times, conflicts developed among the finance team, the program team, and the M&E team over internal team roles. MCA-Malawi tried to delineate staff roles and responsibilities in its grant facility resource requirements document (MCA-Malawi 2014c), but some confusion over roles persisted throughout activity implementation (See Section E below for a detailed assessment of grant oversight.)

At the same time, **grantees were struggling to collect accurate monitoring data as requested by MCA-Malawi.** Difficulties in the collection of monitoring data affected what MCA-Malawi could learn about what was working during activity implementation. One MCA-Malawi staff member lamented that "you find that everyone is trying to focus on the outputs, rather than what is the quality of those outputs" (MCA_3). For instance, a key objective of the grant facility was to fund activities that would reduce the amount of soil erosion into the Shire River. Yet, neither MCA-Malawi nor the grantees had the ability or resources to measure the degree to which grant activities prevented soil erosion. As one MCA-Malawi staff member stated, "Because for this project, we don't know how much [soil erosion] we have reduced, we don't know which intervention reduces more… maybe it would have been cumbersome or… the modality maybe would have been tricky. But maybe in the future we may need to bring in some locally used technologies to check how much erosion has happened" (MCA-2). In that sense, implementation focused on whether funds were spent and whether activities were conducted, but less on how to differentiate between the quality of each grantee's activities.

### 3. Environmental factors

Factors external to the grant facility played only a small role in affecting activity implementation. The donor environment was fairly stable during the implementation period, meaning that the grantees were not sidetracked by other financial crises or major problems plaguing other programs. Notably, though, the Malawian Kwacha (MWK) depreciated during the grant implementation period and after the grant contracts were signed. On August 1, 2015, $1 traded for about 446 MWK, according to Oanda.com. One year later, $1 traded for 710 MWK, a

change of nearly 60 percent. Given that the grants were dollar-denominated, the depreciation had a generally favorable effect on funds available to the grantees to implement their activities. (The currency depreciation did not affect the grantees that budgeted items for import, such as FISD's solar irrigation scheme.)

The grant facility did encounter some environmental challenges. For instance, during the first year of implementation, a drought in southern Malawi adversely affected the tree-planting activities and delayed some other activities that were inadvisable to conduct in drought conditions (MCA-Malawi 2016). Overall, though, environmental factors did not greatly affect activity implementation.

## D. Assessment of intervention location prioritization

### 1. Background

The Middle and Upper Shire Baseline Assessments (LTS International et al. 2011, 2013, and 2014) recommended locations in which ENRM interventions should be prioritized. In this section, we examine whether the selected grantee villages were located in areas in accord with those recommendations (research question 1d).

LTS International et al. (2014) developed a weighting approach that proxied a location's risk of experiencing land degradation and soil erosion—two important factors contributing to sedimentation. The weighting method draws on environmental inputs, such as the risk level for soil erosion and maize cultivation suitability, as well as on social inputs, such as distance to the nearest road and population density. The weighting method then aggregates the inputs into index values, based on environmental and social factors either separately or in combination. In LTS's analysis of the Middle Shire, for example, many locations deemed to be at high risk for land degradation based on environmental inputs were also at high risk based on an evaluation of social inputs. As a result, we observed substantial geographic overlap between the priority areas selected for the combination of both environmental and social inputs and the areas selected solely for environmental factors.

Areas scoring high on LTS's weighting scheme became high-priority areas for the introduction of SLM interventions such as planting vetiver grass, planting bamboo seedlings, and implementing other soil and water conservation measures (LTS International et al. 2014). We reviewed activity locations reported by the grantees and found that each grantee generally implemented the same set of interventions across most of its targeted villages. In other words, at the grantee level, we observed little variation in activity implementation by village.[15] Our analysis therefore focused not on whether individual interventions occurred in high-priority areas but rather examined whether the selected villages were drawn from locations at high risk for land degradation and soil erosion. We focused on land degradation and soil erosion based on

[15] As an example, consider Self Help Africa (SHA), which implemented 15 activities throughout 123 villages. Each village participated in an average of 9.3 activities. Alternatively, SHA implemented each activity in an average of 76.2 villages. If focusing on the 11 most common activities as measured by the number of implementing villages, the number rises to 99.5 activities. These findings suggest that activities were largely bundled as a package, with most villages implementing many of the same interventions.

environmental inputs but not on social inputs because of the substantial geographic overlap between the priority areas identified according to environmental inputs alone and those selected for the combination of both environmental and social inputs. We evaluated the appropriateness of village location according to the following three environmental factors that individually contribute to sedimentation:

- Proximity to waterways, with areas abutting watercourses subject to higher soil runoff risks
- Proximity to areas designated as reforestation opportunities, indicating that tree-planting activities were appropriately targeted
- Surface slope (degrees), with areas at a higher slope subject to greater risk of soil erosion

To evaluate whether the selected villages were located in important areas according to the above environmental factors, we combined GPS coordinates for the 648 villages participating in ENRM/SGEF activities with georeferenced layers representing the Shire River Basin stream network, the areas targeted for Forest Landscape Restoration (FLR), and surface slope. The following section presents our key findings.

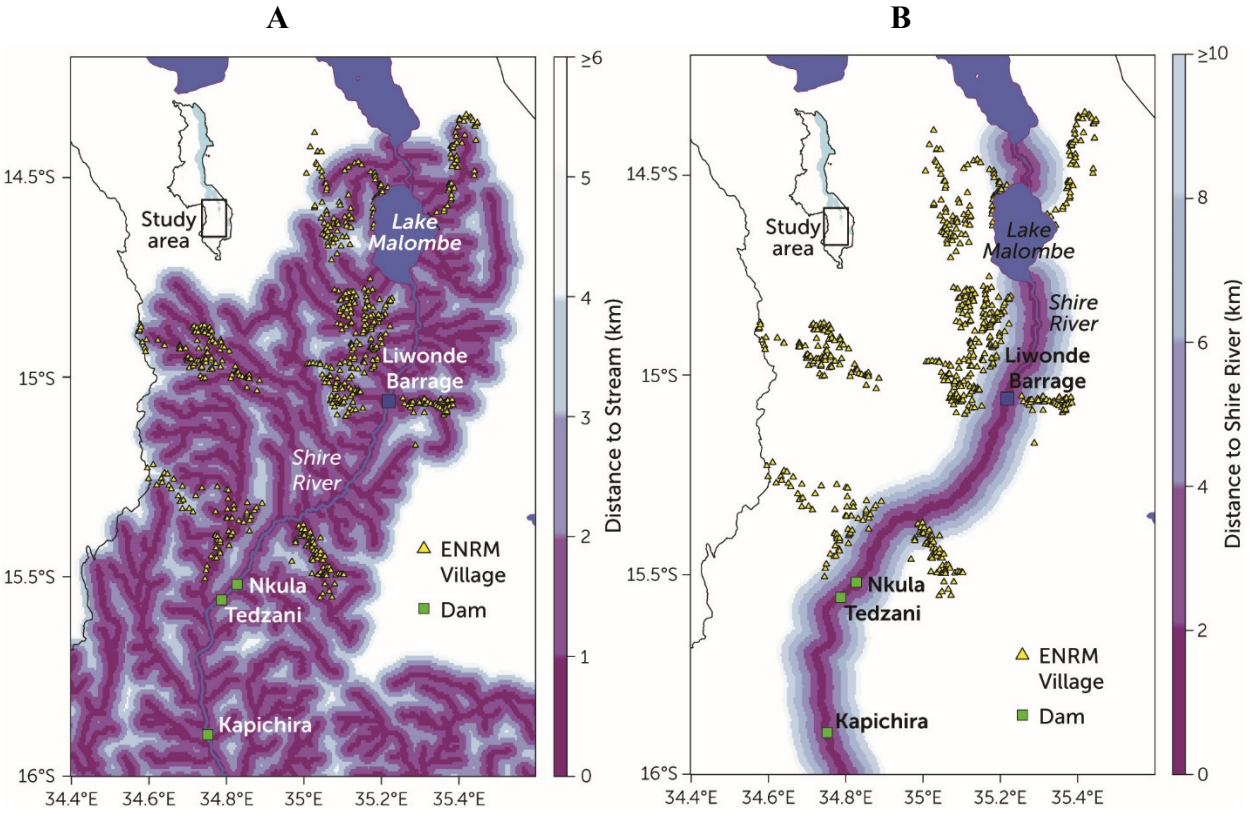
## 2. Key findings

### a. Proximity to waterways

Throughout the Shire River Basin, numerous streams ultimately feed into the Shire River. The agricultural practices adopted on farmland along and near these streams directly affect the sediment loading experienced by downstream locations. Although efforts to promote SLM best practices should ideally focus on modifying agricultural practices throughout the entire river basin, we posit that encouraging the adoption of best SLM practices in villages closer to water bodies will be more effective in reducing sedimentation than advocating for change in villages located farther away from water bodies.

Using the network of streams (appearing in dark purple) from the HydroSHEDS data set (Lehner et al., 2008), Panel A of Figure V.1 depicts the distance to the nearest stream in the Shire River Basin. Locations in the map's region of interest that were more than six kilometers from any stream are shaded in white, emphasizing the distance comparison among locations that were relatively close to streams. The vast majority of villages (yellow triangles) had at least one stream within six kilometers. One notable exception was a small cluster of villages northwest of Lake Malombe targeted by We Effect that were located more than six kilometers from a stream. We believe the most likely explanation is We Effect's emphasis on reforestation and land restoration activities in its project villages (We Effect et al. 2018). Below, we show that these villages were located very close to high-priority areas for reforestation, which may have represented a higher priority in We Effect's site selection process than proximity to streams.

**Figure V.1. Maps of grantee village location relative to water bodies**




Note: Dark purple lines represent the Shire River Basin's stream network, based on the HydroSHEDS data (Lehner et al. 2008). Yellow triangles denote grant intervention villages. Green squares mark the locations of the Nkula, Tedzani, and Kapichira dams. We computed distance calculations by using the GPS coordinates of each grant intervention village and the nearest stream segment from the HydroSHEDS network (Lehner et al. 2008). Panel A presents minimum distance values for the entire stream network, and Panel B distances are relative only to the Shire River.

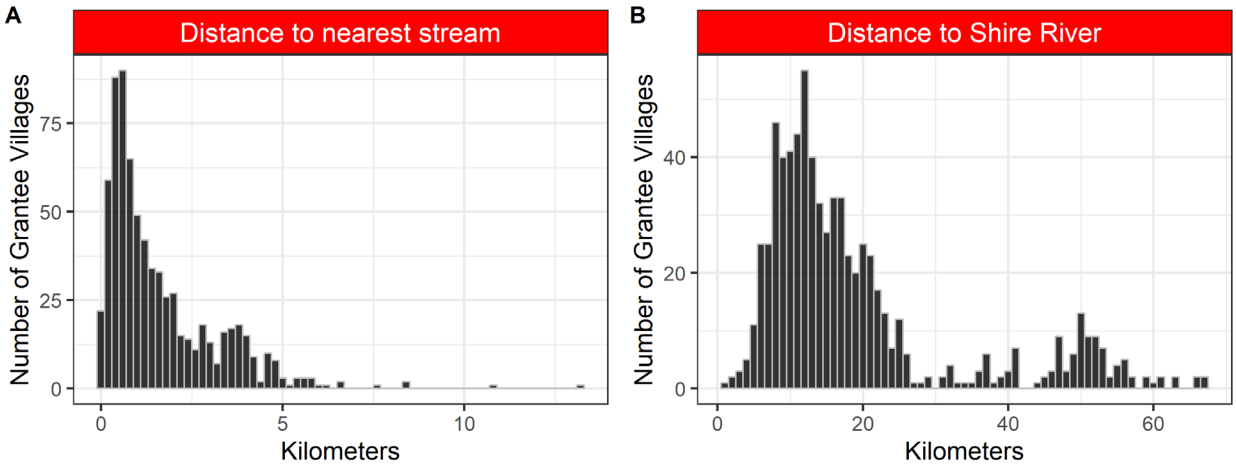
If the focus instead shifts to village proximity to the Shire River, a different picture emerges, as shown in Panel B of Figure V.1.[16] The majority of grantee villages were located substantially farther than 10 kilometers away from the river, as indicated by the yellow triangles against the white background. To gain a more detailed view of the distances from villages to either any stream in the Shire River Basin or the Shire River itself, we present histograms in Figure V.2, respectively, for the minimum distances for each of the 730 village-grantee pairs.[17] Panel A of Figure V.2 shows that nearly all ENRM villages were located near at least one stream. Nearly half of all villages (341, or 47 percent) were no more than one kilometer from a stream, and,

[16] The HydroSHEDS data set does not delineate the Shire River from other water bodies. We therefore used the Global Extent of Rivers and Streams data (Allen and Pavelsky 2018) to obtain the GPS coordinates of the Shire River.

[17] Some villages hosted grant activities funded by several grantees; therefore, this number exceeds the count of 648 unique villages. We find that 59 villages worked with two grantees, 10 with three, and one village with four grantees. Of these 70 villages, 64 were located in Balaka District, 3 in Ntcheu, 2 in Mangochi, and one in Neno. All histograms depict values derived from all village-grantee pairs, which means double-counting those villages working with more than one grantee.

given that the village GPS coordinates correspond to a single point, then villages this close to streams were likely to have many streamside plots. Only 19 villages (fewer than 3 percent) were more than 5 kilometers away from the nearest stream. Panel B presents an alternative way of summarizing the larger distances separating villages from the Shire River, with 26 percent of grantee villages (192) fewer than 10 kilometers away from the river.

**Figure V.2. Histograms of distance between grantee villages and water bodies**




Note: Histograms illustrate distance estimates for the 730 village-grantee pairs. We computed distance by using the GPS coordinates of each grant intervention village and the nearest stream segment from the HydroSHEDS network (Lehner et al. 2008). Panel A presents minimum distance values for the entire stream network, and Panel B distances are relative only to the Shire River.

In summary, we found that the large majority of selected grantee villages were located close enough to streams and other water bodies for their SLM activities plausibly to have contributed to sediment-loading reductions, if in fact the SLM interventions were effective. Despite the selection of a relatively small number of villages adjacent to the Shire River, farming activities in villages farther away but still hydrologically connected to the river through drainage and runoff systems nonetheless affect rates of river sedimentation. Given that distance to water bodies was not the sole criterion in grantees' village selection process, we now discuss two other geographic factors influencing the impact of grantee activities.

### b. Proximity to reforestation opportunities

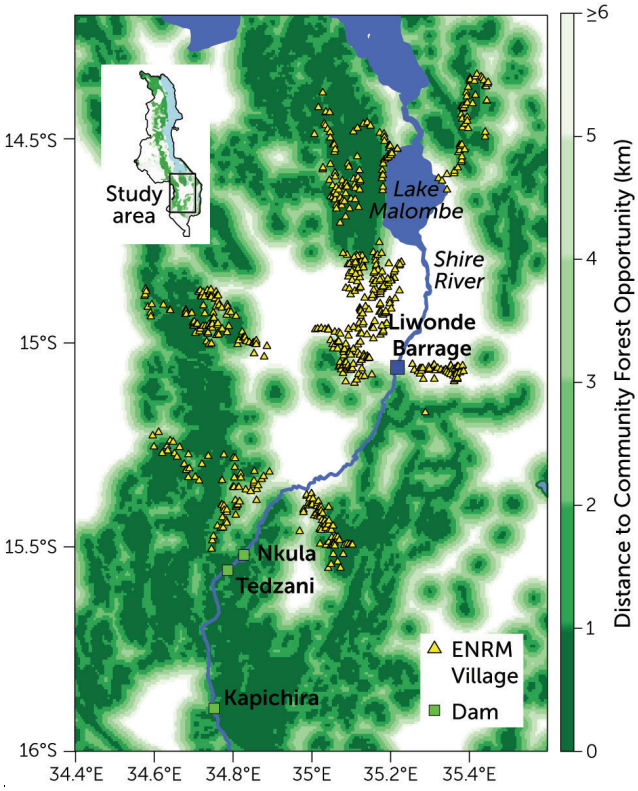
In this analysis, we used spatial data from the National Forest Landscape Restoration (FLR) Assessment on opportunity areas for implementing community forest and woodlot interventions (Ministry of Natural Resources, Energy and Mining 2017), the locations of which are shaded green in the inset map of Figure V.3. The FLR Assessment selected such areas according to a multicriteria analysis that incorporated dimensions of food security, resilience, and biological diversity.

The primary map in Figure V.3 shows that a large share of ENRM villages were located either in or very near reforestation opportunities, as indicated by the yellow triangles in dark green areas. All portions of the map colored white indicate that the nearest opportunity area was more than 6

kilometers away, most readily applying to the clusters of villages southwest of Lake Malombe and east of the Liwonde Barrage. The histogram in Figure V.4 represents the distribution of village-level distance to the nearest opportunity area, with more than 41 percent of villages (298) located within 2 kilometers of a reforestation opportunity area. In contrast, fewer than 9 percent of villages (63) were located more than 10 kilometers away from the nearest opportunity area.

More than 55 percent of the villages in which We Effect and ActionAid Malawi conducted activities were located less than a mile away from a community forest opportunity. In addition, more than 70 percent of the villages selected by We Effect and ActionAid Malawi were located fewer than two kilometers from the nearest community forest opportunity. At least 60 percent of all villages selected by the grantees, including AG Care, THP, and TSP, were located within the same distance from forest opportunities. Even though we lack evidence that either We Affect or ActionAid Malawi intentionally selected villages for their proximity to forest restoration opportunities, the grantees' projects specified objectives such as improving forest cover, establishing tree nurseries, and involving students in nursery and tree-planting activities (ActionAid Malawi 2016; We Effect et al. 2016).

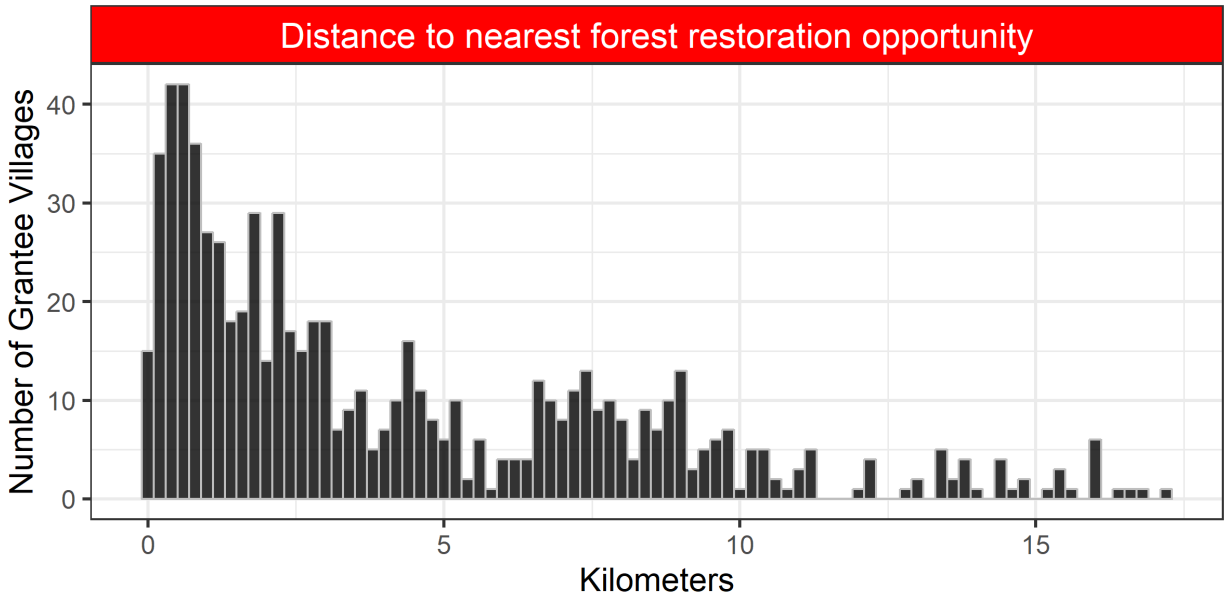
**Figure V.3. Map of ENRM village location relative to reforestation opportunities**




Note: Dark green areas in the inset map and in the primary map represent forest restoration opportunity areas (Ministry of Natural Resources, Energy and Mining 2017). Yellow triangles denote grant intervention villages. Green squares mark the locations of the Nkula, Tedzani, and Kapichira dams. We computed distance calculations by using the GPS coordinates of each grant intervention village and the nearest restoration opportunity area.

United Purpose and Self Help Africa (SHA) were the grantees implementing activities in the largest number of villages—at, respectively, 38 and 15— whose nearest forest opportunity areas were greater than 10 kilometers away. Since United Purpose worked in 213 villages, 38 villages represents a relatively small share of all its village partners, but the 15 SHA villages represented the total of all the villages in which SHA worked. SHA interventions, however, emphasized the "sustainable utilization of forests and promotion of individual woodlots" and appeared to have prioritized tree planting along river banks and tributaries (Self Help Africa 2018).

**Figure V.4. Histogram of grantee village distance to nearest forest restoration opportunity**




Note: Histogram illustrates distance estimates for the 730 village-grantee pairs. Distance calculations are computed by using the GPS coordinates of each grant intervention village and the nearest forest restoration opportunity point from the Ministry of Natural Resources, Energy and Mining (2017).

We found that a large share of villages selected for ENRM/SGEF activities were located close to forest restoration opportunity areas, in line with the recommendations for high-priority activities. Part of this finding reflects the pervasiveness of such opportunity areas throughout the Shire River Basin, as shown in Figure V.3. In reviewing project documentation, we found that grantees working in a large percentage of villages either distant from or near forest restoration opportunity areas did not appear to have selected locations based on forest hotspot recommendations.

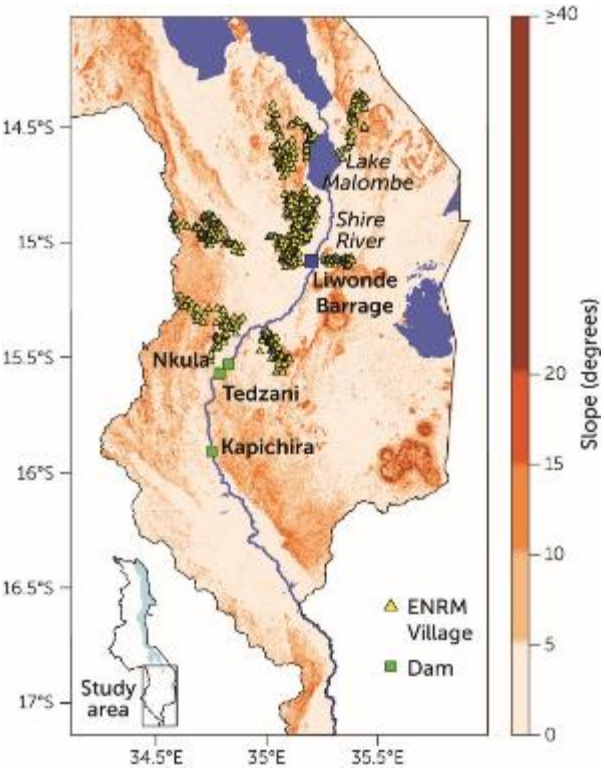
### c. Slope of village location

To evaluate whether selected grantee villages were located on steep terrain with higher erosion risks, we combined village GPS coordinates with an estimate of surface slope by using the Shuttle Radar Topography Mission (SRTM) digital elevation model (DEM), with a spatial resolution of 1 arc-second, which is approximately 30 meters (Farr et al. 2007). Surface elevation values are calculated through interferometry by comparing two reflected radar signals from the earth's surface that are received at different locations on a shuttle orbiting the earth. The slope of

any given location is then computed as the gradient in elevation over a DEM pixel and the four neighboring pixels with which it connects.

In Figure V.5, we illustrate slope values, in degrees, for the entire Shire River Basin. Although the majority of basin territory is nearly level or gently sloping with slope values below 5 degrees, there are areas of steep (8.5 to 16.5 degrees) and very steep (16.5 to 24 degrees) slope, such as in the Malosa Forest and Zomba Nature Reserves and in the Mulanje Mountain Forest Reserve. Given that these high-slope areas are already protected locations in which agriculture is legally prohibited, the slope of potential areas eligible for grantee selection would automatically be relatively lower than these extreme values.

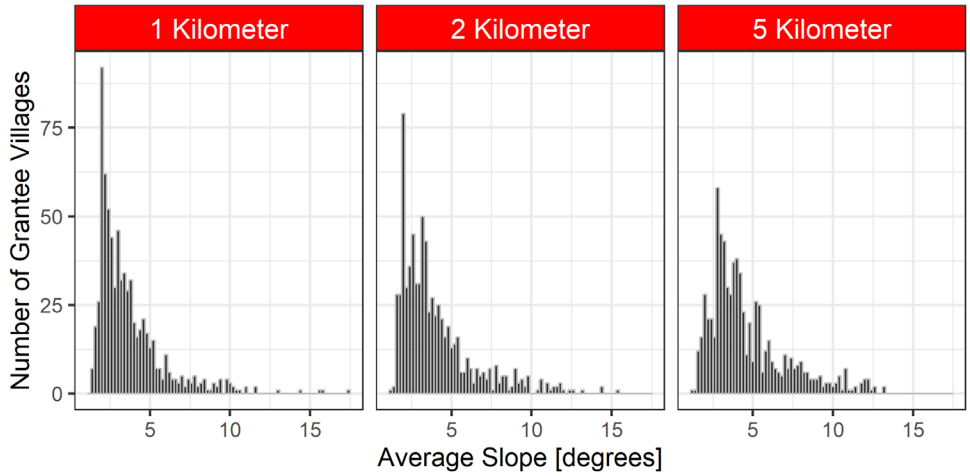
**Figure V.5. Map of grantee village locations and surface slope**




Note: Slope data are derived from the SRTM DEM (Farr et al. 2007), with areas in burnt sienna denoting slope in excess of 20 degrees. Yelllow triangles denote grant intervention villages. Green squares mark the locations of the Nkula, Tedzani, and Kapichira dams.

Our reliance thus far on GPS coordinates for a single location in a village, namely, the location of the village chief's house, has severe limitations for analyzing slope characteristics. By way of example, it is useful to consider a village in which most homes and farmland occupy steeply sloped land while the chief lives in the only gently sloped location. To correct for our reliance on a single location per village, we construct buffers of varying size, centered on the village's GPS coordinates, and compute the average slope over the buffer area. Given that the spatial extent of the village is unknown, we examine several buffer distances (radii) to assess any systematic patterns. In Figure V.6, we present the results of calculations for buffer sizes of one, two, and five kilometers away from the village chief's house. As the buffer radius widens, the overall distribution of village-average slope shifts rightward, indicative of increasing steepness. The vast majority of grantee villages (487 villages) were located in areas with slope averaging fewer than 5 degrees (gentle slope), even when using a generous buffer distance of five kilometers.

**Figure V.6. Histograms of average slope for village-centered buffers of varying distance**




Note: Histograms illustrate average slope values for the 730 village-grantee pairs. Values are based on buffers of the specified radius centered at the village's GPS coordinates. Raw slope values are derived from the SRTM DEM (Farr et al. 2007).

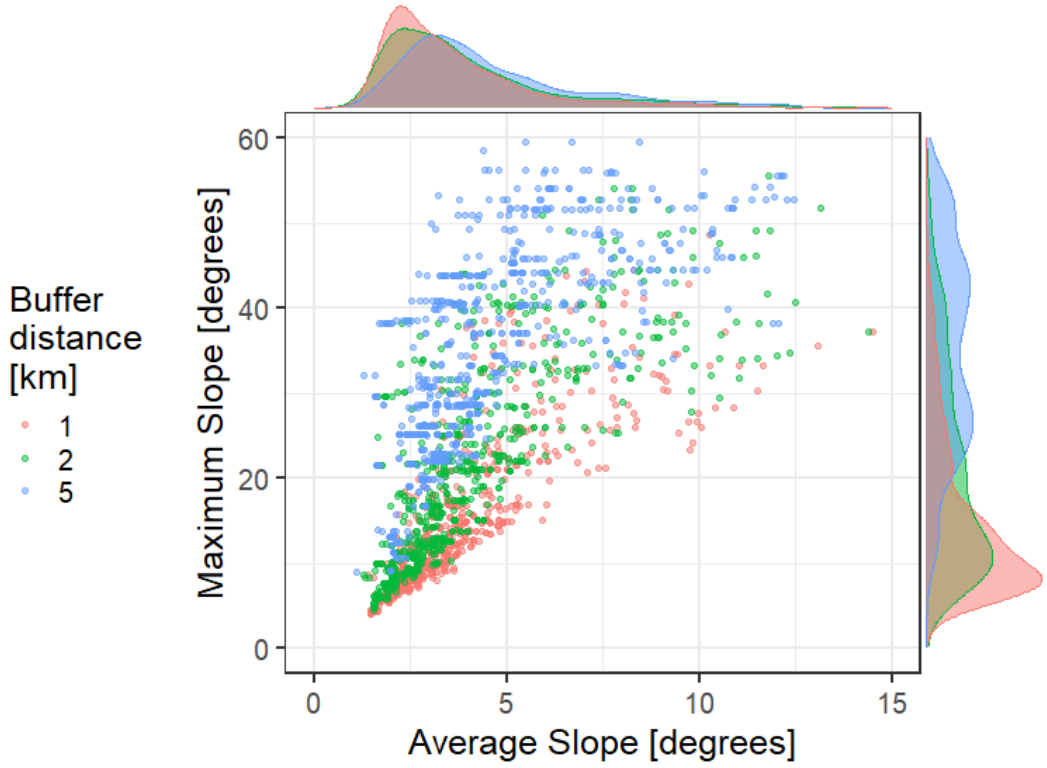
It should be noted, however, that as the buffer distance expands, the number of villages with average slope greater than 10 degrees increases dramatically. In other words, the village center may not be particularly steep, but the village's outer edges are steep. If farmers' plots are located outside the village and require a larger buffer distance for inclusion in a spatial average, then the plots' slope would not be included in small buffer areas. For example, only 2 percent of villages (14 villages) have an area average slope exceeding 10 degrees when using a one-kilometer buffer distance. As the buffer extends to a five-kilometer radius, the percentage of villages more than doubles to 5 percent (37) of all villages. Though still a small share of the total, the pattern of average slope increasing in buffer distance signifies that villages are surrounded by comparatively steeper land. If agricultural production is more likely to take place on these adjacent lands than in the area immediately near the village chief's house, then the average slope for land under cultivation will be higher than that indicated on the map.

ActionAid Malawi was the grantee that selected the largest number of villages in steep areas, whether using a one-, two-, or five-kilometer buffer distance. With the five-kilometer buffer, 16 of the grantee's villages were located on terrain with an average slope exceeding 10 degrees, which is more than half of the total 31 villages in which ActionAid Malawi was implementing interventions. In the absence of evidence from ActionAid Malawi that it selected these villages specifically because of their slope, the grantee said that it was motivated to reduce erosion in hotspot areas (ActionAid 2016). Other grantees were less likely to select villages in steep areas, with AG Care, CCJP, CICOD, FISD, TSP, and We Effect each working in one to five villages whose average five-kilometer buffer slope exceeded 10 degrees. No other grantee worked with such villages.

This approach of taking averages over buffer areas offers the advantage of generating a single value per village, thereby making interpretation straightforward, but it also masks the possibility that large, steep areas in neighboring villages are averaged downward by substantially larger, flat

areas. We therefore used a supplemental approach to identify the maximum slope value of all pixels inside a village buffer and then compared the value to the average value. In Figure V.7, we report the results, with the marginal density plots for average slope (top) and maximum slope (right) presented in colors corresponding to buffer distances displayed in the legend. The plot's key finding is the substantial dispersion in maximum slope values for buffers of all sizes, even when average slope was modest. For example, buffers with an average slope of 2.5 degrees ("very gentle slope") had maximum slope values spanning 6.7 ("moderate slope") to 40.8 degrees ("steep slope"). The kernel density plots of maximum slope values on the right side of the figure highlight the wide range of values, especially for five-kilometer buffer distances. These buffers exhibited a bimodal distribution, with peaks around 27 and 42 degrees. Therefore, even though average slope values suggest that many ENRM/SGEF villages were selected from relatively flat areas, the maximum slope values indicate the presence of steep areas within the vicinity of these villages. Such areas may have been the hotspots where SLM activities were targeted.

**Figure V.7. Average versus maximum slope values for village-centered buffers of varying distance**

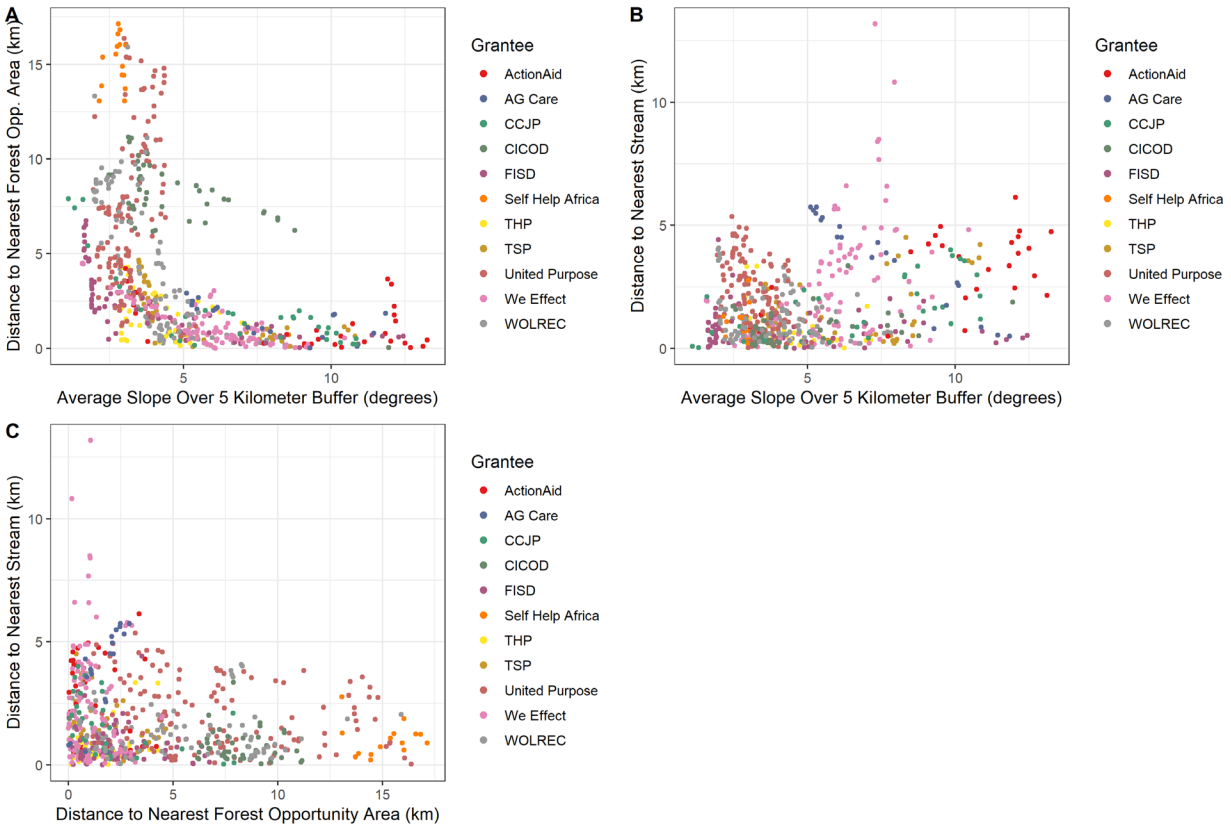



Note: Points represent the average and maximum slope value for each of the 730 village-grantee pairs. Colors correspond to the stated buffer distance from the village GPS coordinates. Kernel density plots showing the distribution of average slope (bottom) and maximum slope (top) are color-coordinated with the buffer distance values shown in the legend. Raw slope values are derived from the SRTM DEM (Farr et al. 2007).

## d. Combined consideration of the three aspects of village location

If we only evaluated village location according to any single factor, we would run the risk of overlooking the relevance of alternative factors. In Figure V.8, we present a series of scatter plots that combine two aspects of village location for each of the 730 village-grantee pairs: average slope and distance to nearest forest restoration opportunity area (Panel A), average slope and distance to nearest stream (Panel B), or distance to nearest restoration opportunity area and distance to nearest stream (Panel C).[18]

**Figure V.8. Scatter plots of grantee village distance to forest opportunity areas, streams, and average slope**




Note: Scatter plots depict the values of two spatial variables for the 730 village-grantee pairs. Average slope estimates are based on five-kilometer buffers centered at the village's GPS coordinates.We derived slope values from the SRTM DEM (Farr et al. 2007). We computed forest and stream distance calculations, respectively,by using the GPS coordinates of each grant intervention village and the nearest forest restoration opportunity point from the Ministry of Natural Resources, Energy and Mining (2017) and the nearest stream segment from the HydroSHEDS network (Lehner et al. 2008).

The pattern exhibited in Panel A indicates that villages in steep areas were located very close to forest restoration opportunities and therefore satisfied two key criteria used in the prioritization schema recommended in the Middle and Upper Shire Baseline Assessments and Action Plan.

[18] For both panels that include average slope on the x-axis, we used a buffer distance of five kilometers from a village's GPS coordinates.

Conversely, villages depicted in the top left quadrant of panel A represent flat areas far away from forests and, accordingly, would not immediately fall under the category of hotspots. Panel B offers a less coherent story of the relationship between steepness and proximity to waterways. A positive relationship is detectible, but the range in stream distance for villages with either low- or high-slope values is comparable. Panel C presents a demonstrable inverse relationship in the tails between distance to streams and to forest opportunity areas. Villages whose nearest water body was located some distance away were situated in or immediately adjacent to forest opportunity areas, whereas villages located far away from such designated reforestation areas were situated extremely close to a stream. It is also important to note that a large cluster of villages is represented near the origin; such villages were close to both streams and reforestation areas. Still, that leaves little to be said about the large number of villages located more than five kilometers from a reforestation area and more than two kilometers from the nearest stream. Because a given village may have been involved in activities spanning relatively long distances, it is also possible that the distance calculations overestimated the true distance of a village to reforestation areas and the nearest stream.

A more conclusive determination of whether the grantees selected the highest-priority areas per the recommendations of the Middle and Upper Shire Baseline Assessments and Action Plan would require a comparison of the land and water characteristics of the selected villages with those of nonselected villages. Without the GPS coordinates for such nonselected villages, we are unable to perform such comparisons. Nonetheless, we focused on three important features that entered into the prioritization process and found strong support that the grantees selected villages that were located in areas where effective interventions could plausibly reduce soil erosion and sedimentation.

## E. Grant oversight

To assess whether MCA-Malawi conducted sufficient oversight of the 11 grantees funded by the grant facility, we analyzed qualitative interviews with MCA-Malawi and MCC staff and with staff at each of the 11 grantees (research question 1e). We triangulated between stakeholder perspectives and identified the key themes emerging from the data. We used an oversight matrix to describe the facilitators of and barriers to programmatic and financial grant oversight.

Overall, we found that MCA-Malawi struggled with the challenge of providing programmatic oversight to 11 disparate grantees. Its internal staff structure, available resources, and staff capacity hindered MCA-Malawi's efforts. Still, MCA-Malawi staff leveraged a variety of technical oversight mechanisms and a collaborative relationship with the grantees to provide productive programmatic oversight; its oversight was just more limited than the ideal. On the financial side, however, MCA-Malawi succeeded in providing sufficient and detailed financial oversight for the 11 grantees. We summarize the results in Table V.3.

**Table V.3. Grant oversight facilitators and barriers**

| Type of grant oversight | Facilitators | Barriers |
|---|---|---|
| Programmatic | • Variety of technical oversight mechanisms<br>• Cross-grant support through quarterly meetings<br>• Productive partnership between MCA-Malawi and grantees | • Limited in-person visits<br>• Limited MCA-Malawi capacity for detailed oversight<br>• Conflicting oversight roles within MCA-Malawi<br>• Unclear communication from MCA-Malawi at times |
| Financial | • Detailed financial checks and corrective action<br>• Focus on implementation timeline | • Changing cost-reimbursement structure |

## 1. Programmatic oversight

**MCA-Malawi and grantee staff members pointed to a robust program for monitoring and for providing technical support and oversight to the grantees.** An important facilitator of programmatic oversight was the variety of technical oversight mechanisms employed by MCA-Malawi. MCA-Malawi developed and distributed activity manuals to the grantees to ensure the provision of uniform and expert guidance in conducting activities such as VSLs and REFLECT circles. As one grant staff member reflected, "All organizations had their own approach to REFLECT, they had their own manuals, so at one [grants] forum [with MCA-Malawi] we discussed that we needed to be uniform and they supported us with a uniform or standard manual for REFLECT for the project. That was great" (GS_4). MCA-Malawi also provided the grantees with templates for reports and templates for tracking key monitoring data. In addition, it conducted workshops and training sessions with grant staff to support their capacity to monitor and evaluate program implementation and track key indicators. MCA-Malawi undertook a variety of monitoring efforts, including programmatic site visits, annual internal evaluations, and interim and final evaluations conducted by an external MCC consultant. Grant staff noted that the in-person site visits illustrated how MCA-Malawi differed from other donors in its level of engagement in activity implementation.

Another facilitator of successful programmatic oversight was cross-grant support through quarterly meetings. Four times a year, MCA-Malawi brought together staff representing all the grantees to discuss common issues and provide uniform feedback. The meetings helped streamline the monitoring and evaluation process and provided a forum for grant staff to learn from one another about the most effective implementation approaches for certain activities. Several grantees emphasized the programmatic benefits of the meetings.

Finally, **a unique aspect for MCA-Malawi as a grantor was that the grantees viewed MCA-Malawi as a partner.** Many grantee representatives commented on the productive relationship they enjoyed with MCA-Malawi and how the latter focused on helping them improve their programs and ensure implementation success. One grantee remarked, "So it was a cordial relationship, they were not doing it like donor, they were doing it like partners" (GS_3). The partnership approach manifested itself in the flexibility MCA-Malawi demonstrated when, for

example, the dynamics in an intervention area warranted the reprogramming of activities. In one instance during implementation, FISD realized that its livestock support activity was adversely affecting its tree-planting activity when the animals started eating the tree leaves. MCA-Malawi supported FISD's proposal to adjust its planned activities.

MCA-Malawi, MCC, and grantee staff also noted barriers that prevented MCA-Malawi from conducting more effective programmatic grant oversight. A constant refrain is that **MCA-Malawi's grant facility team, with so few staff members, lacked the capacity to oversee such a relatively large grant portfolio.** Both MCA-Malawi staff and the grantees remarked that they would have liked MCA-Malawi to have conducted more site visits because the visits proved to be highly useful to both parties. As one MCA-Malawi staff member summarized, "One of the challenges that maybe we faced programmatically and technically is limited visitations to the NGOs. They want visitations as often as possible but sometimes it's very difficult especially when you have got a lot of commitments" (MCA_1). MCA-Malawi staff commented that grantee implementation errors could have been corrected sooner with more oversight staff, noting that one grantee implemented its activity in the incorrect catchment area for almost a year. In addition, many grantees noted that they received few if any comments on their required quarterly technical reports. Clearly, MCA-Malawi did not have the staff capacity to review carefully and provide feedback to all grantees in a timely manner. As one MCA-Malawi staff member reflected on his colleagues' challenges, "But then to put it in a nutshell, these guys have been overwhelmed with work. At some point, you find that even some of the NGOs will tell you that, 'Well, we have to be honest. This is the first donor where we don't see that frequent scrutiny in terms of the report'" (MCA-3).

Another barrier to programmatic oversight concerned MCA-Malawi's staff organization for the grant facility. **Both MCA-Malawi staff and grantee staff reported seeming confusion as to who was ultimately in charge of oversight.** The finance department, the ENRM and SGEF grant officers, and the M&E team seemed to perform overlapping functions. The grantees reported that, in the same week, they would receive several requests from various MCA-Malawi staff on similar topics. Some MCA-Malawi staff transitions during grant implementation exacerbated the confusion over staff roles. In addition, some MCA-Malawi staff recognized that it would have been better to coordinate site visits among various departments. On the implementer side, grant staff asked MCA-Malawi to focus on internal staff coordination before contacting them. One grantee staff member remarked that the grant facility process seemed to be a learning experience for MCA-Malawi as it figured out how best to implement the facility. Other grantee staff members commented that the quarterly meetings were too broadly focused and that activity-specific meetings would have been preferable.

### 2. Financial oversight

**MCA-Malawi and grant staff were unanimous in identifying MCA-Malawi's financial oversight as strong, focused, and detail-oriented.** MCA-Malawi reviewed invoices carefully and, in some cases, even double-checked amounts with suppliers to confirm pricing. In a few isolated cases, such careful oversight resulted in a grantee paying back funds for which it had invoiced. MCA-Malawi also conducted office visits to review the financials of each grantee. One

grantee remarked that the review was a capacity-building experience that supported its staff in learning the process for allowable and unallowable costs, proper documentation, and procurement procedures (GS_5). MCA-Malawi also focused strongly on a grantee's burn rate, demonstrating concern that a grantee might be unable to implement all activities within the three-year project window and using burn rates as a proxy for whether activity implementation was on schedule. Such a provision was generally effective in ensuring that grantees were conducting planned activities and identifying ones that were behind schedule and needed program adjustments. However, one grantee thought that the focus on the burn rate was too narrow and that MCA-Malawi should have looked more at actual activity completion instead of spending. Relatedly, unique to an MCA-Malawi compact was the absence of options for a program extension.

**One barrier, which was a common refrain among the grantees, was the financial reimbursement system.** At the compact's outset, MCA-Malawi provided some upfront activity funds, but it did not do so thereafter such that the grantees had to conduct activities and then request reimbursement. Even though such an approach created a lower-risk financial system for MCA-Malawi, it inhibited some grant programming and delayed some activities. Given MCA-Malawi's robust financial oversight, activity seed funding would have seemed appropriate, especially as it is common in Malawi.

## F. Comparative discussion of a grant facility versus alternative mechanisms

In this section, we assess why MCA-Malawi, in consultation with MCC, settled on a grant facility and if it was the most efficient arrangement for achieving its stated goals (research questions 1f). Using interview data from MCC and MCA-Malawi staff, we examined the economic and programmatic rationale for the grant facility. We then discuss the benefits and drawbacks to other types of grant facilities before highlighting lessons learned from MCC funding of grant facilities under other compacts.

From the time of the compact's earliest development, MCC and MCA-Malawi were committed to support programming that would reduce weeds and sediment in the Shire. During the compact's start-up phase, however, MCC and MCA-Malawi engaged in a decision-making process that shaped the grant facility. Initially, MCC pushed to integrate establishment of the environmental trust with the grant facility. Under this scenario, MCC would provide seed funding to the trust under the compact so that the trust could develop an established grant portfolio before becoming an independent entity post-compact. The trust could use the results from the portfolio activities to leverage donor funding. MCA-Malawi, however, wanted to study further the idea of the trust and fund grants on its own in order to demonstrate the earlier results of the ENRM and SGEF activities. (See Chapter VI for a complete implementation analysis of the environmental trust.) MCC's and MCA-Malawi's differences led to MCA-Malawi's ultimate decision and the compromise that produced the grant facility, structured on a programmatic and financial rationale. The grant facility itself was no small undertaking and required the creation of an infrastructure for soliciting and reviewing applications, disbursing and monitoring funds, assessing grantee performance, and providing financial and technical support to the grantees.

### 1. Programmatic and economic factors

**A grant facility, in theory, allows MCA-Malawi to experiment with different approaches to ENRM and SGEF activities.** With a grant facility, MCA-Malawi could build a body of evidence of successes or challenges and then leverage those successes for the emerging environmental trust as MCA-Malawi sought to expand its impact on reducing weeds and sediment in the Shire. However, MCA-Malawi did not have the resources or capacity to rigorously evaluate the grantees. Instead, this independent evaluation was intended to provide evidence to the environmental trust on the effectiveness of different types of interventions (see Velyvis et al. 2019 for case study results from five of the grantees). Yet, as a practical matter, the differences across grants in the types of planned activities and their related approaches were fairly limited.

**A cost-reimbursement structure under the grant facility provided greater financial control for MCA-Malawi to ensure that money was spent as intended and used for programmatic purposes.** Both grantee and MCA-Malawi staff remarked on the rigor of financial controls, particularly the structure of the reimbursement contract. These processes required substantial effort on the part of MCA-Malawi staff to ensure a proper review of grant financial reports and make certain that funds flowed to grants in a timely manner to support activity implementation. Under an alternative arrangement, MCA-Malawi could have outsourced financial oversight to a third party or could have funded grants before activity completion. Given issues of corruption in Malawi and the limited financial capacity of local NGOs, MCA-Malawi chose to conduct detailed financial oversight in-house where it could more closely monitor financial operations. MCA-Malawi's strong financial management has seemingly provided additional benefits to the grantees. MCA-Malawi staff report that several grantees have been able to identify new funding streams and therefore continue with the activities initiated under the MCA-Malawi grants, albeit with different donors (MCA_4).

### 2. Grant facility alternatives and lessons learned

MCA-Malawi could have pursued several possible options for shaping the grant facility instead of the design they ultimately selected. Regardless of the structure of the grant mechanism, each alternative involved advantages and disadvantages. In Table V.4, we identify alternative grant arrangements suggested by MCA-Malawi and MCC staff. We compare the benefits of and drawbacks to the current grant facility relative to other arrangements, examining both financial and programmatic factors.

Overall, we find that the main drawback to the grant facility was the amount of oversight and management work required to support 11 grants that were relatively small in size but intended to implement a large set of activities over a wide geographic area. Given the compact's time constraints, the effort involved in establishing the grant facility diverted the resources otherwise required to develop the environmental trust. At the same time, though, all alternative options to the grant facility had their own critical drawbacks. The main alternative that would have better supported the trust would have called for eliminating the grant facility as a separate entity in favor of focusing exclusively on creation of the trust. Such an approach would have potentially ruled out grant making during the compact but would have set up the trust for long-term success.

**Table V.4. Grant facility alternatives' benefits and drawbacks**

| Grant facility alternative | Benefits | Drawbacks |
|---|---|---|
| Current grant facility design (includes grants to national and international organizations) | • Demonstrates benefits of a grant program to donors and policymakers within a short period<br>• Sets up operations and procedures that could be used by the trust<br>• Provides a pilot of grant activities for the trust to consider | • Requires substantial oversight, management, and resources on MCA-Malawi's part<br>• Diverts attention from creating a trust |
| Creation of independent trust with sustainable financing to continue beyond the close of the compact | • Ensures trust is operational prior to close of compact<br>• Ensures trust has an operating portfolio of grants before seeking external funding | • Requires considerable upfront work to obtain financing, limiting time for grant implementation<br>• Results take some time to become visible<br>• Requires identification of financing sources ahead of time |
| Subgrant to one or a few large international NGOs | • Limits MCA-Malawi resources needed for oversight and management of grants<br>• Leverages international expertise from a large organization | • Does not support a transition to an environmental trust<br>• Does not support sustainability of grants |
| Grant making focused on CBOs | • Leverages local knowledge and experience<br>• Supports local capacity building<br>• Helps make grant activities more sustainable | • Requires considerable oversight, more than the grant facility design selected<br>• Requires resources devoted to capacity building<br>• Grantees may be too limited to implement activities effectively |
| Provide funding directly to an already established trust | • Trust infrastructure already in place<br>• Established record of fund raising and grant portfolio | • Trust mission may not align with compact's preferences<br>• Limited influence over grant procedures and trust mission |

In addition to contrasting the benefits of and drawbacks to alternative grant arrangements in Malawi, we tried to glean lessons learned from grant facilities funded by MCC under other compacts around the world, including three compacts that ran concurrently with the Malawi compact. In Indonesia, MCC funded a green prosperity grant facility that aimed to reduce the country's reliance on fossil fuels and to improve land use practices and natural resource management. The grant facility was much larger in terms of funding and grants. It supported 72 grants, with planned disbursements of $253 million (Social Impact 2018). In Zambia, MCC funded an Innovation Grants Program (IGP) to provide support to community-based organizations, civil society, and private sector entities working in the areas of water, sanitation, and solid waste management, with planned disbursements of $6 million. The grant facility's objective was to expand access to water, sanitation, and hygiene (WASH) services in peri-urban areas of Lusaka. In Cabo Verde, MCC funded a grant facility as part of a WASH-focused

project. With nearly $19 million in signed contracts, the grant facility provided infrastructure grants to increase access to piped water, along with grants to NGOs that worked with communities to connect homes to newly piped waterways and deliver other WASH interventions.

Through our reviews of compact documents and evaluation materials and our discussions with grant facility evaluators, we noted several common themes that demand consideration when implementing a grant facility:

- **Grant facilities involve a high administrative burden.** A significant drawback for grant facilities is the substantial administrative and management requirements needed in establishing and then adhering to a wide range of procedures and processes. In particular, grant facilities need procedures for the review and award of grants as well as for program monitoring and financial oversight. Such activities are especially burdensome for smaller grant facilities or those making many grants in relatively small amounts. In these cases, the administrative overhead may be disproportionately large relative to the grants' benefits. MCA-Malawi staff noted the high administrative burden associated with the grant facility and the challenges associated with grant oversight. The grant facility in Zambia also struggled with administrative and oversight burdens.
- **Grant facilities provide a flexible intervention approach and support activity experimentation.** One benefit across grant facilities is that they can fund several intervention approaches, permitting the piloting of new strategies allowing for a comparison of different implementation structures. In this way, a grant facility can provide lessons as to which approaches are most effective and warrant scale–up, as was particularly true in Indonesia with a compact portfolio of 72 grants.
- **Grant facilities support spreading activity benefits widely.** Instead of one organization implementing an activity in one area, a grant facility can spread benefits more widely by funding several organizations working in many communities. Such an approach also allows organizations with specific local knowledge to implement smaller programs in targeted communities. These organizations can assume greater ownership of program design as a reflection of their direct connection with the grant facility (as opposed to working through an intermediary contractor). A large implementer may not be successful in reaching all the communities served by smaller implementers. Smaller implementers also tend to be local or community-based NGOs. In Malawi, for instance, implementers received grants to work in areas with which they were often experienced and in which they enjoyed established relationships.
- **It is unclear if grant facilities promote intervention sustainability post-compact.** Several grant facilities were designed to encourage additional funding post-compact in order to sustain effective intervention approaches. However, it remains to be seen if grant facilities do, in fact, support sustainability. It is not clear if a facility ceases operation upon termination of a compact, regardless of how much time and energy went into creating the facility. In Cabo Verde, MCC is trying to get the government or foreign donors to continue funding similar WASH infrastructure grants after conclusion of the compact.

## G. Assessment of grant facility objectives

In this section, we examine the extent to which the grant facility achieved its overall objectives and how those objectives aligned with recommendations from the baseline Upper and Middle Shire environmental reports (research questions 2 and 2a). We first trace how the baseline environmental reports influenced the creation of the grant facility and then assess the grant facility objectives.

### 1. Influence of the baseline environmental reports

The baseline environmental reports identified the magnitude of the sedimentation and weed growth problem in the Upper and Middle Shire River, including key contributing economic, environmental, and demographic factors. The reports also identified hotspot locations in which MCA-Malawi should focus its funding. These hotspots were defined as areas causing a disproportionality high level of sediment runoff into the Shire River (LTS International 2011 and 2013). Given that the Shire River Basin is so large, the identification of hotspots provided a way for MCA-Malawi to prioritize its resources to produce the largest effect. Beyond the specific location recommendations, the baseline reports provided high-impact intervention recommendations to reduce sediment runoff and weed growth throughout the Shire River Basin. The recommendations called for more traditional conservation agriculture and forest management activities (such as interplanting and crop rotation to increase crop production, mulching and manuring to increase the soil's organic matter, and planting trees and grass for riverbank protection), along with activities focused on women's empowerment and improved gender equity (such as supporting VSLs, establishing water user associations, and providing fuel-efficient cook stoves).

**The grant facility effectively operationalized the recommendations in the baseline environmental reports.** The grant facility wholly incorporated recommendations for intervention types and location into the grant facility manual. As a result, MCA-Malawi worked with prospective grantees to distribute interventions across as many of the identified hotspots as possible. Of the 12 identified hotspots, grants operated in four of the five priority hotspots in the Middle Shire and four of the seven in the Upper Shire. In four catchment areas, two grantees operated in the same hotspot, with one grantee conducting activities in two areas. The grantees also conducted many similar interventions per the recommendations in the baseline environmental reports. The one exception was an early recommendation for conducting biocontrol interventions—a recommendation later deemed by MCC as too environmentally risky to fund.

Grant staff reported that they initially sought to work in areas where they were most experienced, but MCA-Malawi would sometimes ask grantees to propose their activities in different catchment areas so that MCA-Malawi could maximize coverage of the recommended hotspots (GS_1 and GS_4). As part of the application process, the grantees received copies of the baseline environmental reports; several organizations reported that they used the reports to guide the activities they proposed (GS_2 and GS_3). In this sense, the grant facility implemented the activity type and location recommendations of the baseline environmental reports.

**Grant facility documentation also demonstrated how the grant facility used the baseline environmental reports to help it articulate its mission and objectives.** The grant facility's policy guidelines document provided the clearest description of the aims of the facility, stating the following as its objectives (MCA-Malawi 2014b):

1. To provide financial and technical assistance to NGOs, community-based organizations, and farmer organizations to enable them to work effectively with communities in the targeted watersheds in the Shire River Basin in ENRM and SGEF activities;
2. To promote active participation of different gender groups; men and women in the implementation of interventions in the environmental natural resources management action plans aimed at addressing soil erosion, sedimentation and aquatic weed infestation in the Shire River;
3. To support the adoption and scaling up of appropriate ENRM and social and gender enhancement activities in targeted catchments in the Upper and Middle Shire basin for sustainable control of environmental degradation;
4. To provide lessons for the establishment and management of a sustainable financing mechanism for ENRM and SGE activities and form the basis for the establishment of a Trust Fund to be later managed under the framework of the Shire River Basin-wide management entity; and,
5. To raise awareness on the state of the environment of the Upper and Middle Shire River Basin and promote collective community actions that nurture local solutions to local problems.

The objectives aligned with the project's program logic and theory of change (Figure I.3) whereby the grant facility sought to improve sustainable land management both directly through more traditional ENRM activities and indirectly by addressing social and gender inequities. The grant facility also provided evidence for the emerging environmental trust as to which activities and approaches proved most effective for future funding and scale-up.

## 2. Grant facility achievements

We now examine the extent to which the grant facility achieved its intended objectives. We drew on interviews with MCA-Malawi grant facility staff, MCC staff, and grantee activity staff as well as on an extensive review of grant facility documentation and findings from our in-depth case studies of five grants (see Velyvis et al. 2019). In Table V.5, we summarize the evidence we found that both supports and challenges whether the grant facility achieved each objective.

Overall, we find that the grant facility succeeded in addressing many of its core objectives. In particular, the facility exceled at promoting the integration of ENRM and SGEF activities, a unique model that was broadly supported by stakeholders. It also raised general awareness about the importance of communities' implementation of SLM practices—a theme echoed by other donors. At the same time, the grant facility faced challenges in fully achieving several of its objectives. Clearly, it provided valuable financial and technical assistance to the grantees and helped develop an evidence base for the environmental trust, but facility staff faced an

overwhelming workload in overseeing 11 disparate grants and dealing with some grantees' limited capacity to monitor activity outputs and outcomes. The grant facility reported achievement of its intended outputs for ENRM activities, but unfortunately did not have the resources, capacity, or a plan to provide reliable measures on adoption of SLM practices. As the trust is not yet operational, it is unclear how much, if any, of the grant facility's operational structure and intervention evidence the trust will use.

**Table V.5. Assessment of grant facility achievements**

| Objective | Evidence of achievement | Challenges with achievement |
|---|---|---|
| Financial and technical assistance to grantees | • MCA-Malawi staff dedicated to supporting grantees<br>• Grant staff report receiving assistance, including quarterly meetings and activity manuals | • Lack of timely MCA-Malawi feedback on quarterly grant activity reports<br>• Substantial management tasks for MCA-Malawi to oversee 11 grants |
| Promote active participation of men and women to improve SLM practices | • All grants integrated ENRM and SGEF activities<br>• MCA-Malawi employed staff dedicated to supporting integration of SGEF<br>• Activities aligned with recommendations from environmental assessment reports | • Some grantees were more experienced than others with one type of activity and thus had to learn how to integrate activities during implementation |
| Support adoption and scale-up of ENRM and SGEF activities | • MCA-Malawi staff provided technical support to grantees<br>• Grant case studies identified high adoption levels of ENRM practices<br>• Some grantees obtained follow-on funding from other sources to continue and scale activities | • The environmental trust is still not operational<br>• MCA-Malawi staff reported inadequate staffing for delivering sufficient assistance to grantees<br>• Grant activities covered a small area of the Shire River Basin<br>• Activities did not always cover the entire agricultural value chain |
| Provide evidence and the basis for the environmental trust | • MCA-Malawi conducted and commissioned several evaluations of the grants for activity learning<br>• MCA-Malawi worked with grantees to collect and review monitoring data on activity progress | • MCA-Malawi and MCC staff expressed concerns that monitoring data were of low quality<br>• The emerging trust had yet to adopt much of the grant facility's structure and documentation |
| Raise awareness about the state of the environment and promote community actions | • Grant facility and trust created linkages with other key actors<br>• Some promising early sustainability findings from individual grantees | • Too early to assess if grant interventions will produce lasting effects |

**Grant facility staff worked hard to enhance the technical and financial capacity of the grantees and provided venues to strengthen intervention approaches; however, staff were hampered by the scope of the operational and management tasks associated with overseeing 11 grants.** MCA-Malawi hired technical staff dedicated to providing support to and oversight of the grantees. Activities included the development of manuals for activities such as REFLECT circles and VSLs, convening grant activity staff each quarter to discuss cross-cutting issues and implementation challenges, and carefully reviewing grantee financial systems. At the

same time, many MCA-Malawi staff reported that they were overwhelmed by the workload and therefore were not able to provide adequate support to the 11 grantees dispersed over a large intervention area. Grant activity staff noted that they received often late and minimal feedback on their quarterly activity reports.

**The grant facility successfully promoted the integration of SGEF and ENRM activities, with sufficient staff support to help those grantees with little experience in implementing SGEF activities.** One unique aspect of the grant facility was the targeted integration of gender-focused activities into households' decision making, households' division of labor, and women's leadership in traditional land management activities. Some grants had not previously conducted SGEF activities, but all grants integrated ENRM and SGEF interventions, and many noted that SGEF activities were positive facilitators of ENRM adoption (for further information, see our comparative analysis of five grant case studies in Velyvis et al. 2019). MCA-Malawi exceeded its targets for all SGEF activity indicators, including the number of community members engaged in SGEF activities, part of community- or village-level committees, and participation in REFLECT circles and VSLs (Table V.6). There was still a learning curve for some grantees with little, if any, experience in implementing SGEF activities, but MCA-Malawi employed staff dedicated expressly to supporting SGEF grant activities and thus overall achieved its objective.

**Table V.6. Grant facility progress indicators and results**

| Indicator | Result | Target | Percentage of target |
|---|---|---|---|
| Trees survived | 4,306,890 | 2,868,473 | 150% |
| Trees planted | 6,943,879 | 4,451,618 | 156% |
| Leaders trained in natural resource management issues | 7,751 | 6,745 | 115% |
| Male | 3,564 | 2,900 | 123% |
| Female | 4,187 | 3,845 | 109% |
| Community members engaged in SGEF initiatives in targeted areas | 73,676 | 52,670 | 140% |
| Male | 24,199 | 22,454 | 108% |
| Female | 49,477 | 36,126 | 137% |
| Number of women who enrolled in and completed leadership training | 4,222 | 2,787 | 151% |
| Community members who were members of community- or village-level committees | 18,547 | 8,560 | 217% |
| Male | 7,543 | 4,206 | 179% |
| Female | 11,004 | 4,354 | 253% |
| REFLECT/Reflection-Action Circles operational | 448 | 312 | 144% |
| Community members participating in operational REFLECT/Reflection-Action Circles | 16,469 | 6,761 | 244% |
| Male | 4,695 | 1,676 | 280% |

| Indicator | Result | Target | Percentage of target |
|---|---|---|---|
| Female | 11,774 | 5,085 | 232% |
| VSLs operational | 907 | 447 | 203% |
| Community members participating in operational VSLs | 27,096 | 19,245 | 141% |
| Male | 5,605 | 7,466 | 75% |
| Female | 21,491 | 11,799 | 182% |

Source: MCC Malawi compact Indicator Tracking Table (ITT), close-out (3/20/2019).

Note: Indicator results represent cumulative progress among all 11 grants funded by the grant facility for the duration of their three-year programming.

**The grant facility achieved its reported targets for ENRM activities, but it was unable to track key measures of practice adoption. Activities were too diffuse and sometimes lacked the market linkages needed to produce higher-level effects on sediment runoff and income generation.** MCC reported that it exceeded its targets for all ENRM-reported outputs, including trees planted and survived and leaders trained in natural resource management (Table V.7). However, MCC and MCA-Malawi were unable to effectively track other key ENRM outputs and outcomes, including the number of farmers trained and the adoption rates for specific practices such as marker ridge alignment, digging swales, using organic manure, and not cultivating on steep slopes or near riverbanks. Still, MCA-Malawi and MCC staff reported consistent, positive impressions of the grantees' ENRM work. As one MCA-Malawi staff member commented, ". . . [E]fforts have been made by the NGOs working with the farmers to reduce soil erosion, where they have encouraged them to follow new techniques of farming; instead of tilling the ground, they have been adopting zero tillage and mulching" (MCA_4). MCA-Malawi staff also reported that several grantees received follow-on funding from other sources to continue working on SLM activities in the same communities where they initiated such activities.

The grant facility faced two other challenges related to achievement of the ENRM outcomes. First, even though individual grants may have increased the adoption rates of ENRM practices, they were operating on a small scale within the overall Shire River Basin and across several sites. MCA-Malawi and MCC staff recognized that these interventions alone would not affect the total amount of sediment flowing into the Shire River. As one MCA-Malawi staff member noted, "The thinking is that we scattered the NGOs too thinly over the hotspots or the NGOs had too many activities to do. We did not focus or concentrate efforts in a particular hotspot or intervention" (MCA-4). With the trust yet to be operational, it is unclear if and how these activities will be scaled up to a level that would substantially affect soil erosion. Second, MCA-Malawi staff expressed concern that the ENRM interventions did not address the entire agricultural value chain as recommended in the baseline environmental reports. For example, the activities demonstrated only minimal linkages, if any, to agricultural markets and did not address transportation improvements to help farmers access markets. These interventions could go a long way toward improving farmer welfare and could be addressed by the environmental trust.

**The grant facility created an evidence base of its work. However, staff expressed concerns with the validity of some of the grant-reported monitoring data, and activities demonstrated little variation across grants.** In some ways, the grant facility provided an opportunity to pilot both a structure and interventions for the emerging environmental trust. MCA-Malawi and MCC emphasized the importance of monitoring and evaluating the grants throughout the life of the compact in order to generate lessons for itself and the trust. In addition to Mathematica's independent evaluation, MCC commissioned a consultant to conduct annual process evaluations of the grants (see, for example, Murray 2018). The MCA-Malawi Monitoring and Evaluation team also conducted annual grants evaluations and worked with the grantees to collect monitoring data on a common set of indicators (MCA-Malawi 2015, 2016).

Further, the results showed the limitations in the data that were collected and in how the grant facility operated. Many funded activities were similar across grants, limiting the amount of experimentation and diversification of approaches. There were some innovations, such as FISD's solar irrigation scheme and TSP's clan-focused approach, but not many. In addition, grant activities lasted only three years, but many were trying to effect behavioral change, making it difficult to link the duration of interventions and the dosage needed to achieve the intended effects. As one MCA-Malawi staff member noted, "The three years that we have been on the ground were only the beginning of the big job that is there and therefore we might see that there isn't much change on the ground but it's mainly because change takes much time especially when we are talking of behavioral change" (MCA_4). Finally, given that the trust is not operational, it has yet to adopt any grant facility structures, including its application selection process, grant monitoring and technical guides, and financial oversight systems. It remains to be seen what, if any, of the work that went into the grant facility will guide and support establishment of the trust.

**The grant facility raised awareness about and promoted community actions related to SLM.** The grant facility raised the awareness of key donors and actors about the immense challenges associated with sustainable land management and how poor land management was causing problems for hydropower production. The World Bank concurrently invested in a project to improve land management in the Shire River Basin by establishing the Shire River Basin Management Authority. With the close of the compact, the work to sustain these outcomes has shifted to the GoM through its follow-on agency, MMDT. Our grant case studies found beneficiaries optimistic that the gains made during the grant activities would be sustained and that farmers would continue to adopt SLM practices. However, it is too early to assess if the grant intervention will have lasting effects on behavior change.

# VI. FINDINGS FROM THE ENVIRONMENTAL TRUST EVALUATION

**Summary of key findings**

**Implementation**

- Early lack of agreements between MCC and MCA-Malawi as to how to structure the trust and grant facility delayed the implementation of the trust. That factor, along with poor implementation on the part of the contractor, left too little time for the successful establishment and operation of the trust before the close of the compact
- The trust has a functional board of directors made up of the key stakeholders for land management in the Shire River Basin. However, board members have limited availability for their tasks and need permanent technical staff to advance the trust's work. After we completed data collection for this report, the trust identified a board member to serve as trust coordinator.
- The Malawi Energy Regulatory Authority (MERA) approved an increase in the environmental management levy for EGNECO, and MCC reported a deal in principle for EGENCO and ESCOM to pay for initial trust operations through the electricity levy. After we completed data collection for this report, EGENCO signed a one-year agreement with the trust to provide funding at a level lower than in the approved levy. ESCOM has not provided a formalized, written commitment to fund the trust..

**Sustainability**

- It is uncertain if the trust will be successfully launched and sustained in the coming years. It has key supporters in Malawi and prospects for sufficient capital, but there will need to be a strong champion outside MCA-Malawi and MCC to change the trust from an idea to reality.

As part of the ENRM activity, MCA-Malawi, with support from MCC, intended to establish an environmental trust to provide sustainable funding for land management activities in the Shire River Basin once the compact concluded, similar to what was funded for ENRM and SGEF grant activities. By the closeout of the compact, MCA-Malawi, with substantial support from MCC, had helped to establish the trust known as the Shire Basin Environmental Support Trust (Shire BEST). It is too early to assess whether the still-developing trust will succeed. Instead, this interim evaluation will examine the implementation process for establishing the trust and stakeholder perceptions of trust sustainability. Our final evaluation report will assess whether the trust becomes operational and financially sustainable. In this chapter, we address the following research questions:

1. Which implementation factors supported or hindered establishment of the trust?
2. To what extent is the trust on track to reach administrative and operational sustainability?
   a. Did the trust establish a funding mechanism, such as Payment for Ecosystems Services, and obtain sufficient capital to sustain grant investments beyond the life of the compact? Why or why not?
   b. What is the trust's fund-raising strategy for achieving sustainable financing over the long term? How was it developed?[19]

[19] The evaluation design report included a third research question focused on the experience of the implementing consortium at that time: "How did leaders of the implementing consortium use their organizations' experiences to (continued)

For this analysis, we draw on interviews with board members of the Shire BEST as well as on interviews with key staff members at MCA-Malawi and MCC who supported establishment of the trust. We also examined trust documentation, including its strategic plan, investment policy, funding proposals, and monitoring and evaluation plan.[20] We begin by providing an overview of trust implementation since the design phase of the compact. We then assess early results of the trust by comparing actual outputs to what was planned per the trust feasibility study (Spergel 2015). Next, we analyze trust implementation by using the implementation effectiveness framework. We conclude with interim findings on trust sustainability based on stakeholder perceptions.

## A. Overview of trust implementation

We begin our analysis by providing a broad overview of trust implementation from September 2013 through October 2018.

**Given the limited five-year duration of MCC compacts, MCC wanted the Malawi Compact to include a strong sustainability mechanism right from the design phase.** MCC staff recognized the magnitude of the environmental problem in the Shire River Basin and the challenges associated with changing farming behavior, even on a small scale, in such a short time frame (MCC_4). MCC's ultimate objective was to create an environmental trust with a sustainable funding mechanism that could fund interventions—through grants— to improve land management in the Shire River Basin, reducing sedimentation and weed growth in the Shire River. MCC initially envisioned that the grant facility would be part of the environmental trust. The grant facility would then transition into an independent entity during the life of the compact, along with a portfolio of established grants and some successful results to show future funders. During the compact design phase, however, MCC and MCA-Malawi disagreed on how to structure the grant facility and the trust. Some MCA-Malawi stakeholders preferred to run the grant facility in-house for the duration of the compact in order to show rapid results from their work. These stakeholders believed that the concept of the trust required further study and that the trust should operate separately from the grant facility.

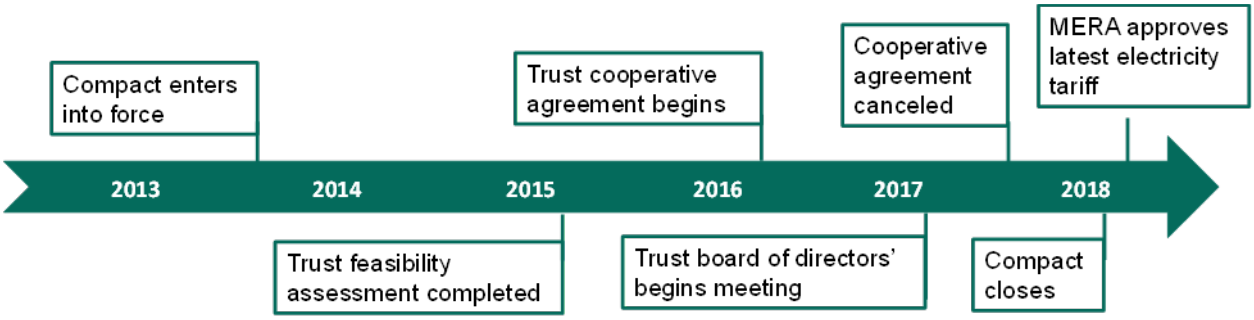
As a result, MCA-Malawi contracted with an environmental lawyer to conduct a trust feasibility study, which was completed in early 2015. The feasibility study laid out clear outputs for establishing the trust, including the needed operational, financial, and administrative conditions, as well as a prospective trust development timeline with key steps (Spergel 2015). MCC staff were worried that the time was too short after completion of the feasibility study to establish the trust given the trust examples from other countries cited in the study. At that time, there were

establish the trust? What lessons did these leaders draw from their own grant-making experience that they applied to the establishment of the trust?" However, MCA-Malawi terminated the contract with the implementing consortium for nonperformance before the trust was established. Therefore, that research question is no longer applicable here.

[20] We completed data collection for the trust in December 2018 but have updated our findings to include key developments in the trust through September 2019.

fewer than three years to establish the trust before the close of the compact. In Figure VI.1, we provide a timeline of environmental trust implementation.

**Figure VI.1. Key events for environmental trust implementation**




Following a review of the trust feasibility study, MCA-Malawi, with substantial support from MCC, decided to contract with an implementing organization to be tasked with establishing the trust, including registering the trust, drafting the key legal documents and operational frameworks, and, most crucially, setting up a funding mechanism. MCA-Malawi's initial procurement for the work failed. They received only one bid—and at an unacceptable level of quality. During the second procurement attempt, MCC and MCA-Malawi met with a consortium of stakeholders to encourage them to submit a joint bid that covered the key expertise needed for establishing the trust. Ultimately, the successful bid was led by the Mulanje Mountain Conservation Trust (MMCT), an endowed trust south of Blantyre that works in the Mulanje Mountain Forest Reserve to support biodiversity and environmental sustainability. MMCT was joined in the cooperative agreement by the Malawi Environmental Endowment Trust (MEET), an endowed grant-making organization that supports community-based organizations in Malawi; the Wildlife Conservation Society (WCS), an international organization with expertise in payment for ecosystem services' (PES) financing mechanisms; and the International Union for Conservation in Nature (IUCN), which offers experience in analyzing ecosystem services.

**At the time of the signing of the cooperative agreement, the nature of the trust financing mechanism was not clear.** One possibility for financing was that the compact could provide seed funding for the trust to create an endowment. Another possibility was that companies located near the Shire and that consume a large volume of water for their operations would fund the trust through a PES in order to reduce sediment and weed growth in the river. Yet one more possibility was that other international donors would support the trust. MCC was also advising MCA-Malawi to consider a combination of these approaches to fund the trust.

MMCT set up a secretariat in Blantyre to work full-time on creating the trust. However, given MMCT's poor performance, including low quality work and severely delayed deliverables as well as financial improprieties, MCA-Malawi terminated the cooperative agreement with MMCT in late 2017. MCC and MCA-Malawi then took over the work to establish the trust. MCA-Malawi hired a local consultant to assist with drafting key documents. MCC redirected staff and consultant time to focus on finalizing the trust's funding mechanism.

**By the end of the compact, MCA-Malawi, with MCC's substantial support, was able to establish the trust on paper and get it officially registered with the Government of Malawi.** The trust has a functioning board of directors composed of key stakeholders in the Shire River Basin, including leaders of ESCOM, EGENCO, MERA, MMCT, Africa Parks, Illovo Sugar, civil society organizations, Old Mutual, and the Shire River Basin Management (SRBM) Program. The board is in the process of approving and revising key trust documents such as the strategic plan, business plan, and monitoring and evaluation plan. EGENCO and ESCOM have committed in principle to providing initial financing for the trust. In October 2018, MERA approved the latest electricity tariff, including an increased levy for environmental management costs. EGENCO intends to transfer to the trust some of the funding from this line item, and eventually signed a one-year funding agreement with the trust after we completed data collection for interim evaluation. The SRBM Program has offered the trust subsidized office space in its new building in Blantyre.

**Even though MCA-Malawi and MCC were able to salvage development of the trust, many challenges remain.** By the end of the compact, the trust did not employ any permanent staff and it lacked office space and even a bank account to receive funds. The trust existed mainly on paper, along with a volunteer board of directors whose members have many other responsibilities and commitments. However, by September 2019, the trust did identify one of its board members to serve as the trust coordinator and obtained office space.

## B. Early trust results

Even though Shire BEST has yet to become operational, MCA-Malawi did achieve key benchmarks in the process of establishing the trust. As part of the feasibility study, Spergel (2015) laid out a prospective timeline and steps required to establish the trust. We revisited the relevant key steps in that timeline to assess the extent of trust implementation and to identify the work that still needs to be done. We summarize the key steps and implementation results in Table VI.1.

## Table VI.1. Key steps and implementation results for the environmental trust

| Key trust step[a] | Main finding | Summary of implementation results |
|---|---|---|
| Establish trust steering committee | Achieved | The trust implementers initially established a steering committee. The committee soon became the trust's board of directors. |
| Trust steering committee meets regularly until trust is legally established | Achieved | The steering committee met while it was still the steering committee. The board also met a few times since its establishment, with board members saying that they intend to meet quarterly. Meetings, however, tend to be delayed because of scheduling conflicts. |
| Hire trust coordinator | Partially achieved | MCA-Malawi initially contracted with a consortium led by MMCT that hired a trust coordinator to establish the trust. MCA later canceled that contract for nonperformance and hired a consultant to complete the work. The consultant's contract ended at the close of the compact in September 2018. After we completed data collection for this report, the trust identified a board member to serve as trust coordinator. |
| Develop name, mission, vision, programmatic focus, and objectives of the trust | Achieved | These tasks were completed by September 2018; however, the board may still need to revise and approve some parts of the trust's vision and objectives. |
| Regularly coordinate/communicate with government stakeholders | Partially achieved | There was a breakdown in communication with the MMCT consortium amid the implementation challenges. According to interviews with board members, there did not seem to be a clear understanding on the current status of key issues, such as trust funding. |
| Draft trust legal documents (trust deed, articles of incorporation, constitution) | Achieved | These documents were drafted by September 2018, but the board could still amend them. |
| Legally register trust | Achieved | The MMCT consortium completed this task in 2017. |
| Officially appoint trustees | Achieved | The trust has a functioning board of directors. |
| Hire trust executive director | Not achieved | No permanent staff have been interviewed or hired. |
| Open trust bank accounts | Partially achieved | The trust was in the process of obtaining a bank account when we completed data collection. As of September 2019, we learned that the trust had obtained a bank account. |
| Obtain office space, equipment, and supplies for the trust | Partially achieved | At the time that we completed data collection, the trust lacked office space but planned to occupy subsidized office space in the SRBM Program building in Blantyre; some corporations have reportedly offered to donate office equipment and supplies. More recent reports indicate that the trust did obtain office space. |
| Draft terms of references to hire permanent staff | Partially achieved | Early drafts for some staff are available but still need to be finalized. |
| Approve an investment policy and investment guidelines | Partially achieved | Consultants prepared an early version of an investment policy and guidelines for the trust, but the board needs to review and approve the document. |
| Approve an operations manual | Partially achieved | The early versions of financial and administrative management manuals still need to be finalized and approved. |

| Key trust step[a] | Main finding | Summary of implementation results |
|---|---|---|
| Secure funding for the trust | Partially achieved | MERA approved a revised electricity tariff that includes an increase in EGENCO funding for environmental management, which could be a precursor to a formal PES mechanism. EGENCO has indicated that such funding could be allocated to the trust. ESCOM has also expressed support for funding the trust. The board has identified other possible funding sources, including the World Bank. However, the trust is still looking to secure bridge funding and initial funds to hire staff and become operational. EGENCO and the trust signed a one-year limited funding agreement. ESCOM and the trust have yet to sign a formal funding agreement. |
| Hire an international investment manager | Not achieved | Not yet hired. |
| Draft call for proposals, including grant application forms and reporting requirements | Not achieved | Not yet conducted. |
| Issue call for proposals | Not achieved | Not yet issued. |

[a]Spergel (2015) developed the key trust steps.

The trust was able to complete many key steps, including registering with the government, establishing a functional board of directors, and drafting key operational documents. However, implementation fell short of what was specified in Spergel's report. Many documents will remain in draft form until a trust secretariat is established, though a secretariat cannot be established until the board secures funding for the trust.

**The trust has made some progress on funding.** In December 2017, the Shire BEST provided a proposal to ESCOM and EGENCO for initial funding of the trust through an increase in the electricity tariff. The trust proposed three tariff options (low, medium, and high) that would provide between approximately $700,000 and $1.6 million in revenue per year for the trust's first four years of operation, equating to around 0.7 to 2 percent of overall tariff revenue (MCA-Malawi 2017). EGENCO and ESCOM decided to include the lowest level of funding for the trust in its tariff application to MERA; MERA approved the funding level in October 2018. According to trust documents, the lower funding level "is the minimum required to secure operations of the Trust and attain some field results" (Shire BEST 2018a). The lower funding level would limit the trust in making grants to organizations, with the large share of the funding allocated to trust start-up and overhead costs. After we completed data collection, EGENCO and the trust signed a one-year agreement to provide funding at a level lower than in the approved levy.

**Even with the highest funding scenario, the trust recognized that it would have to engage in additional fund raising from other sources in order to achieve its grant-making goals.** The trust's draft strategic plan does have a focus on a "multipronged" fund-raising approach, including pursuing multi- and bilateral donors, foundations, and corporate giving (Shire BEST 2018a). The trust also created a two-page document to promote itself to partners and donors. These fund-raising documents appear to be mainly the work of a consultant hired by MCA-Malawi. Now that the compact has concluded, it is unclear who will assume fund-raising responsibilities and further develop a nascent fund-raising strategy.

**While EGENCO and the trust signed a memorandum of understanding (MoU), the funding agreement was only for one-year and there is still no formal funding agreement between ESCOM and the trust.** Until the trust has a clear agreement on financing and funds begin to flow to the organization, it will not function and not be able to hire permanent staff, endangering its ability to achieve operational and administrative sustainability. The trust is currently stagnating at the point of achieving the initial inputs described in its program logic (Figure I.3 in Chapter I). In recognizing the delays associated with establishing the trust, MCC noted that many of the larger questions, such as financing, should have been frontloaded at the outset of the term of the compact. Resolving the funding issue should be a top priority for the Malawi Millennium Development Trust (MMDT), board members, and other trust stakeholders.

## C. Trust implementation effectiveness

To critically assess implementation of the environmental trust, we employ an implementation effectiveness framework in which we classify implementation facilitators and barriers as intervention design characteristics, implementation process characteristics, and environmental factors.

Overall, we find that the trust encountered substantial implementation challenges that were compounded by a poorly performing contractor with limited oversight, the failure to specify the trust funding mechanism, and a short time frame for establishing an independent trust. The trust required a stronger staff focus earlier in the life of the compact. Still, the flexibility and resourcefulness of MCC, MCA-Malawi, and other stakeholders did help the trust achieve some initial development benchmarks. In Table VI.2, we summarize our findings from this analysis.

**Table VI.2. Trust implementation effectiveness framework**

| Implementation frame | Facilitators | Barriers |
|---|---|---|
| Intervention design characteristics | • Alignment between trust and other aspects of the ENRM project | • Separating trust from grant facility<br>• Funding mechanism decision timeline and process |
| Implementation process characteristics | • MCC resources and staff support | • Incompetent implementer<br>• Lax implementer oversight<br>• Lack of understanding of and stakeholder engagement in PES |
| Environmental factors | • Key stakeholder support for the trust<br>• World Bank support for the SRBM Program | • U.S. government legal requirements for establishing trusts<br>• Economic conditions of corporate supporters of the trust |

### 1. Intervention design characteristics

**The trust was designed to take advantage of other ENRM project activities and resources.** MCC envisioned the grant facility as a proto-trust, providing an opportunity to pilot grant making and develop an evidence base that would guide the trust's work. Such an approach would help the trust identify effective interventions to be funded while learning how to streamline

grant-making procedures. The approach would also allow the trust to leverage the resources developed by the grant facility, including its call for proposals, proposal review criteria, technical support resources, financial oversight systems, and monitoring and evaluation plans.

However, **key design decisions for the trust ended up being barriers to successful implementation.** Given the early objections from MCA-Malawi, **the trust was separated from the grant facility**. MCA-Malawi thought it would take too long for the trust to be established and provide grants. It wanted to fund grants on its own in order to demonstrate early results of the ENRM and SGEF activities. In a way, such an approach led MCA-Malawi to create two grant-making organizations; that is, the grant facility provided grants during the compact while the trust would provide grants after the close of the compact. Yet, the trust is not reaping the benefits of all the work that went into the grant facility, including experience in conducting financial and technical oversight of grants. Most crucially, the trust began operations without a grant-making portfolio or a track record of supporting organizations that are making positive land management contributions in the Shire River Basin. That lack of a track record also prevents the trust from leveraging early results for fund raising. Donors want to see proof of an organization's effectiveness before they provide financial support. And, finally, with the close of the compact, the launch of the trust will be much more difficult in the absence of MCC's and MCA-Malawi's support. Separating the grant facility from the trust was a lost opportunity for developing the trust. However, at the same time, the separation between the grant facility and the trust did allow the grant facility to succeed in providing three-year grants to 11 organizations. In other words, the trust would have benefited from being linked to the grant facility, but the arrangement could have also inhibited and delayed implementation of the grant facility.

**MCC had not come to an agreement with MCA-Malawi on a funding mechanism for the trust during the design stage.** The funding mechanism is the most important aspect of the trust; without it, the trust will cease to exist. The lack of clarity on the funding approach had ripple effects throughout the implementation process, and those effects continue to this day. The three main funding ideas at the outset follow:

- **Endowment approach.** MCC would provide seed funding for the trust through compact funds. USAID successfully used a similar approach in Malawi to create MEET. However, MCC later found that it lacked the statutory language to establish an endowment. Legislation had also outlawed USAID's ability to establish an endowment. MCC looked into other creative avenues to seed fund the trust, but none was tenable.
- **PES mechanism.** This approach mandates that large economic beneficiaries of the Shire River Basin—namely, large water users such as the power companies, water boards, and corporations—pay a levy to ensure sustainable environmental management of the basin. The levy would pay for the trust's operations and grants. Several Latin American countries have followed a similar approach, but the idea was novel in Malawi.
- **Donor fund raising.** The trust would raise money from interested international donors and the Malawi government for use in conjunction with options (1) or (2) as a supplemental revenue source.

Of the options, the endowment approach is the most common one in Malawi. Both MCCT and MEET began their operations through an endowment, which is the easiest approach to explain to stakeholders. Although MCC had to reject the endowment approach to fund the environmental trust a few years ago, trust board members continue to bring up some sort of seed financing as a needed first financing step. MMCT was focused on the endowment approach, drawing on its experience in and understanding of the work it would perform under the cooperative agreement. The lack of clarity on the financing mechanism and the amount of time it took to identify the most tenable financing option hindered stakeholders' ability to establish the trust.

### 2. Implementation process characteristics

**The trust implementation process saw an almost perfect confluence of barriers that severely handicapped the implementation process.** To carry out the cooperative agreement, MMCT hired new staff to establish a secretariat that would oversee the day-to-day tasks related to operationalizing the trust. According to MCC, MCA-Malawi, and other activity stakeholders, the secretariat proved to be an incompetent implementer. Its work was severely behind schedule and of inferior quality. One of the secretariat's early deliverables was a trust constitution that copied language from MMCT's constitution and never mentioned the PES mechanism. In addition, MCA-Malawi and MCC accused the secretariat of financial fraud, and litigation continues in Malawi related to the secretariat director's theft of office vehicles and computers. Poor oversight by both MMCT, which was awarded the cooperative agreement, and MCA-Malawi compounded the secretariat's incompetence. MMCT is based in Mulanje, and the secretariat had offices in Blantyre such that MMCT had little direct oversight of the secretariat. MCA-Malawi, based in Lilongwe, was also unable to conduct robust oversight and may have let issues plaguing the secretariat fester longer than was prudent. MCA-Malawi and MCC were distracted by other significant compact issues, including procurement problems related to the WSM activity (Chapter IV) and the institutional reforms within EGENCO and ESCOM that concerned another aspect of the compact. In a way, the compact's ambitious scope overshadowed implementation of the trust, and the trust's problems occurred at a particularly inopportune time for MCA-Malawi.

Connected to poor implementation, **two underlying issues fed into one another: the choice of the financing mechanism and project communication.** MMCT was under the impression that the trust would be endowment-funded. It hired secretariat staff with such an arrangement in mind. MMCT was not communicating well with the secretariat, but MCA-Malawi and MCC also did not communicate clearly with MMCT about the changing focus of the financing mechanism. Implementers sometimes received conflicting messages from MCA-Malawi and MCC, leading to confusion as to who was spearheading the decisions about the financial mechanism, with one implementer expressing "shock" with the shift away from an endowment-based approach. Part of the confusion could also have been attributable to staff changes within MCA-Malawi. The compressed time available for establishing the trust before the close of the compact only compounded these several challenges. In fact, once MMCT understood the shift to the PES mechanism, it discovered that its team lacked the expertise and political gravitas to establish a PES with the time remaining on its contract. It also lacked an MoU with the power companies to facilitate working relationships. Further, MMCT had limited time available to establish the PES

before the electricity tariff application was due to MERA. The application review process occurs only once every four years and was up for review in 2018. As one implementer put it, "A PES is not something you can go and contract very easily. It needs broad partnership, it needs a measured implementation period" (IP_1).

Further, **many stakeholders were not familiar with PES mechanisms, and some key stakeholders were not fully engaged in the process to develop the PES.** As one MCC staff member noted, a PES is "a new concept, a new idea for Malawi. It took a lot of kind of education to get this idea across to [the stakeholders], there [are] just not that many examples in Africa where it is working" (MCC_4). MCC did support a study visit to Costa Rica with MMCT to observe a successful PES. Other stakeholders, such as ESCOM, seemed less sure about the value of the PES, perhaps in part because of ESCOM'S involvement in a wide range of compact activities. The PES may have just represented too much work on top of all other compact activities that ESCOM had undertaken.

**MCA-Malawi and MCC were able to rescue trust implementation by rapidly redirecting resources and staff to address the implementation problems.** Once it canceled MMCT's cooperative agreement, MCA-Malawi hired a trust coordinator as a consultant to draft many of the remaining deliverables, including the strategic plan, business plan, and monitoring and evaluation plan. MCC also played a large role in establishing the trust by devoting resources from its head office and contracting with consultants to support establishment of the PES and work closely with EGENCO, ESCOM, MERA, and the GoM. This marshaling of resources was a successful facilitator for trust implementation at the time when prospects for the trust were poor.

### 3. Environmental factors

In the background, several environmental factors supported and hindered trust implementation. **Driving the establishment of the trust was key stakeholder support.** EGENCO, ESCOM, and the GoM all realized the seriousness of the land management problem in the Shire River Basin and wanted to address it in order to improve electricity generation. They saw the trust as an important long-term vehicle to resolve the issue. This is evidenced by EGENCO and ESCOM's participation on the trust board of directors, EGNECO's increase in its environmental management budget to support the trust, and the GoM's continuing efforts to push for establishment of the trust post-compact through MCA. Other key stakeholders are also engaged in the trust's development, including the World Bank, which is funding the SRBM Program. The SRBM has offered subsidized office space for the trust, and the World Bank has expressed interest in supporting the trust in the future.

**Some other environmental factors also hindered the establishment of the trust.** As noted, with U.S. government agencies legally prohibited from endowing trusts, MCC was unable to rely on the easiest financing option to fund the trust. And even though EGENCO and ESCOM have come around to the PES approach, their continuing economic straits make it hard for them to find funds to support the trust. Other large water users of the Shire River Basin are in similar economic condition. The Blantyre Water Board is experiencing financial difficulties and facing a

management transition. Illovo Sugar recently lost its privileged access to the European Commission market. The Carlsberg beer company in Malawi suffered a huge loss as a result of fraud and was sold to another brewery. Despite these users' continuing interest in the trust, their limited funds prevent financial support of the initiative without a binding legal requirement.

## D. Prospects for trust sustainability

Given that the trust is not yet operational, it is too early to assess its organizational sustainability. However, we do use a sustainability matrix to examine the prospects for sustainability along several dimensions based on the perceptions of trust stakeholders and trust documentation. Namely, we assess stakeholder commitment and incentives, financial resources and institutional capacity, and political support.

Overall, we find that if stakeholder commitment and political support for the trust persist and the trust can identify a champion to operationalize it, the trust could attract the needed financial and human capital to function as a grant-making organization. However, there are serious risks to the trust becoming operational, particularly without MCC engagement now that the compact has closed. We summarize our findings in Table VI.3.

**Table VI.3. Analysis of trust sustainability dimensions**

| Dimensions | Facilitators | Barriers |
|---|---|---|
| Stakeholder commitment and incentives | • Key stakeholders on the Shire BEST board of directors<br>• Economic incentive for improved WSM for EGENCO | • Competing stakeholder priorities<br>• Lack of local ownership<br>• No signed MoU with ESCOM |
| Financial resources and institutional capacity | • Environment management funding included in the electricity tariff<br>• Subsidized office space from SRBMA<br>• World Bank interest in trust<br>• Trust documents as a roadmap | • Corporate stakeholders in financial straits<br>• No permanent trust staff<br>• No trust bank account |
| Political support | • GoM and MMDT support trust<br>• MCC plans second Malawi compact | • MCC compact has ended and MCA-Malawi has closed down |

### 1. Stakeholder and incentives commitment

An important facilitator that bodes well for trust sustainability is **strong commitment from key stakeholders on the board of the directors.** Several board members agreed on the importance of the environmental trust and expressed their strong support for establishing the trust. The board includes leaders from EGENCO, MERA, ESCOM, and civil society organizations working in the Shire River Basin. Further, MMDT, the GoM follow-on agency to MCA-Malawi, appears committed to helping the trust become operational. EGENCO in particular has a financial incentive for the trust to operate successfully. Even though EGENCO may end up paying for a large part of the trust operations from its electricity tariff, the trust should lead to cheaper and more efficient electricity generation in the long run by reducing weeds and sediment in the Shire.

There are still barriers, though, to stakeholder commitment. **Stakeholders, particularly board members, have many other competing priorities** and are serving as board members in a volunteer capacity. It may take many years for the trust's grants to result in positive environmental changes whose economic impacts benefit stakeholders. In the meantime, stakeholders are concerned with the financial viability of their own organizations as well as with working with other donors on more immediate programs. There is also a general concern about the lack of local ownership. It is a big leap from a trust on paper with a volunteer board to a functioning organization. The trust needs a champion to advance it to the next phase. One MCA-Malawi staff member remarked that trust sustainability "depends on who is in the driver's seat. So, by the end of the day, if there is somebody that is innovative, that has got the drive to push and ensure that things happen, I think it's going to happen" (MCA_1). MCC staff echoed this sentiment by saying, "If you had a dynamic leader in the Secretariat, there is a lot of money going into Malawi and you could basically use the PES as way of leveraging more resources and coordinating. You could really become a one-stop shop for a lot of donors who are interested in protecting the environment or watershed management, even food security" (MCC_4).

### 2. Financial resources and institutional capacity

**A huge success with the trust thus far was the increase in EGENCO's environmental management line item in the newly approved electricity tariff**, with an understanding that those funds could be directed to support the trust. For a standalone line item in the tariff, EGENCO will need to be able to identify a clear relationship between costs and benefits, in this case, the reduction in sedimentation. If the trust is able to invest in monitoring and evaluation to analyze its effectiveness, the resulting information could be available for the next tariff application round in 2022, potentially showing that the environmental management costs would pay for themselves through more efficient hydropower generation. The trust board also reported that it identified other potential funding sources, including matching funds from the World Bank, equipment and supply donations from corporations that rely on the Shire, and supplemental funding from foreign governments. In the absence of permanent funding, board members have been pooling their resources in order to continue to meet. MMCT noted that it has helped finance board meetings. The SRBMA has offered subsidized office space to the trust. MMDT is looking for funds, perhaps from the GoM, to provide bridge funding for the trust.

**The trust board and any future staff will inherit several key documents developed under the compact to guide trust operations**, including a strategic plan, monitoring and evaluation plan, and investment guidelines. These documents provide a roadmap for the trust board and future staff on how to fund raise for, set up, and organize the trust, including specific steps to take over the next five years. One notable omission from the documents is any reference to social and gender activities or their integration with more traditional ENRM activities. SGEF activities were a major focus of the MCA-Malawi grant facility, and yet they are completely absent from trust planning. It is unclear if their absence represents an oversight or reflects different visions and priorities. Nonetheless, the trust will have access, in theory, to the resources developed by the grant facility. However, with the closeout of the compact, it is unclear what mechanism exists to transfer these resources and knowledge to future trust staff— and even if the trust staff would accept resources developed without their buy-in.

**There is a substantial risk that the trust will not receive the requisite funding.** Despite significant interest among many stakeholders to fund the trust and EGENCO's apparent strong financial commitment, it is unclear what will happen next and whether EGENCO will follow through on its pledge to provide environmental management funds to the trust. EGENCO recently signed a one-year funding agreement with the trust, but the amount was lower than what was earmarked in the environmental management levy. ESCOM, and the trust have yet to sign an MoU. Many other large water users are in a difficult financial situation, including the Blantyre Water Board, Illovo Sugar, and Carlsberg beer. Many funders will want to see results before providing financing, yet the trust first needs money to achieve results. One MCC staffer notes that it will be a major challenge for the trust to show that it can appropriately manage financial resources (MCC_6), especially given that corruption in Malawi is widespread.

### 3. Political support

**Wide-ranging political support for the initiative burnishes the prospects for the trust's sustainability.** The GoM is supportive of the trust, as reflected in the fact that the trust is a priority for MMDT, which has assumed responsibility for the trust instead of delegating it to another government agency as in the case of other compact follow-up activities. MMDT has also been advocating with the GoM for bridge funding for the trust, along with legislation that would mandate large water users to pay into the trust. Further, MCC recently announced that Malawi has been selected for a second five-year compact. MCC's further investment in the country provides additional political leverage to ensure the viability of the trust. Strong political support from these actors can also be instrumental in generating financing for the trust by legitimizing the trust as an institution and engaging in donor outreach.

At the same time, **MCC and MCA-Malawi are no longer available to push the trust forward directly.** MCA-Malawi and MCC had assumed most of the responsibility for establishing the trust—a responsibility that now falls on the volunteer board members and staff of MMDT. MCC staff expressed pessimism that the trust would move forward successfully without its involvement. Overall, the trust remains in a precarious position. The trust requires local ownership, which has been lacking so far. As one MCC staff member summarized, "The jury is still out on whether the trust will actually work or not. All the pieces are there if somebody is willing to pick them up" (MCC_4).

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# VII. FINDINGS FOR THE OVERALL ENRM PROJECT

**Summary of key findings**

### Remote sensing imagery analysis

- From 2015 through 2017, close to 7 percent of the land area in the Shire River Basin experienced land cover change. Overall trends suggest accelerated deforestation and cropland expansion. Deforestation rates for the basin are high; for comparison, they are similar to deforestation rates for all of Malawi and for Mozambique and are greater than those for Tanzania and Zambia. When focusing on high-risk erosion hazard areas in the basin, we found that a large share of deforested area is in high slope areas and that agricultural land is encroaching onto riverbanks. These findings suggest that areas facing high erosion risk are undergoing conversion to biomes that exacerbate soil erosion.

### SWAT model analysis

- We modeled the effects of a policy scenario that would expand SLM practices in the Shire River Basin and predicted sediment inflow reductions for the Nkula, Tedzani, and Kapichira reservoirs on the scale of 30 to 40 percent. Reductions in sedimentation would help retain reservoir storage capacity and reduce loss of hydroelectric power production capacity when compared against a business-as-usual scenario without the widespread adoption of SLM practices. The incorporation of climate change forecasts into the simulations led to reductions in sedimentation rates resulting from predicted reductions in precipitation levels.

### Performance evaluation

- All project activities were aligned with the theory of change, which posited that, for hydropower generation to increase, weeds and sediment would need to be reduced by using mechanical equipment and changing land management practices. However, MCC and MCA-Malawi were implementing an ambitious set of activities for a five-year compact and had limited experience in procuring dredging equipment and setting up a trust in Malawi.
- MCC and MCA-Malawi demonstrated strong implementation flexibility as they adjusted to conditions on the ground and particularly poor contractor performance.
- As the project had yet to achieve a reduction in weeds and sediment in the Shire River, it was too early to assess higher-level outcomes associated with power generation and reliability. In fact, in the final quarter of the compact, average power plant utilization was a disappointing 55 percent, well below the compact's target of 90 percent, because of low water levels, plant maintenance, and high levels of weeds and sedimentation.
- At the close of the compact, key stakeholders remained committed to project activities, and the GoM has committed resources to see activities through to completion, but it was too early to tell whether the project outputs and outcomes will be sustained.

In this chapter, we assess the overall ENRM project by answering the following research questions:

1. How has land use along the Shire River changed during the ENRM project?
2. If the project activities were expanded throughout the area, how would the activities affect sedimentation in the Shire River based on alternative modeling scenarios?
   a. How would reductions in sedimentation affect hydropower production based on the alternative scenarios?
3. Based on the results of each activity's evaluation, which implementation factors supported or hindered the effectiveness of the ENRM project overall?
   a. How did ENRM project implementation vary from what was planned, and why?

   b. How did these changes in implementation affect overall outcomes?

4. Did the ENRM project achieve its targeted intermediate and final outcomes and contribute to higher-level compact objectives? Why or why not?
   a. Were there any unintended consequences of the program (positive or negative)?
5. Based on the results of each activity's evaluation, what are stakeholders' perceptions of the sustainability of outcomes achieved under the ENRM project, and why?
   a. What could or should be done to increase sustainability?

We answered the first two research questions by conducting a remote sensing analysis of geospatial mapping data and using the Soil and Water Assessment Tool (SWAT) to model soil erosion and sediment runoff in the Shire River Basin. To answer research questions 3 through 5, we synthesized activity-level findings as part of an overall project performance evaluation.

## A. Remote sensing findings

**Nearly 7 percent of area in the Shire River Basin (inside Malawi, south of Lake Malawi), or 156,078 hectares, experienced some type of land cover change (LCC) from 2015 through 2017.**[21,22] We first discuss net changes to the area under each biome and then describe the transitions that collectively sum up to these net area changes.

**Throughout the basin, croplands and grasslands experienced the largest expansion in total area from 2015 through 2017, whereas shrublands and forest underwent the largest contractions, as shown in Table VII.1 and Figure VII.1.** We also observed both deforestation and cropland expansion when focusing only on the high erosion hazard areas of riverbanks and steep lands (slope exceeding 20 percent). Grasslands continued to be the most dominant biome throughout the Shire River Basin, and their area expanded by nearly 6,000 hectares from 2015 through 2017. Croplands were the second most extensive biome, and, over the period of interest, expanded by nearly 13,000 hectares. This change is consistent with other countries in sub-Saharan Africa where cropland is expanding at the expense of forests and other biomes (Gibbs et al. 2010).

[21] We used data from 2015 through 2017, as data for 2018 were not yet available. We are planning to carry out a follow-up analysis with data for additional years in the final evaluation report in 2021.

[22] The total basin area covers approximately 2.3 million hectares.

**Table VII.1. Area of land cover and land cover change in the Shire River Basin by biome, in hectares (000s)**

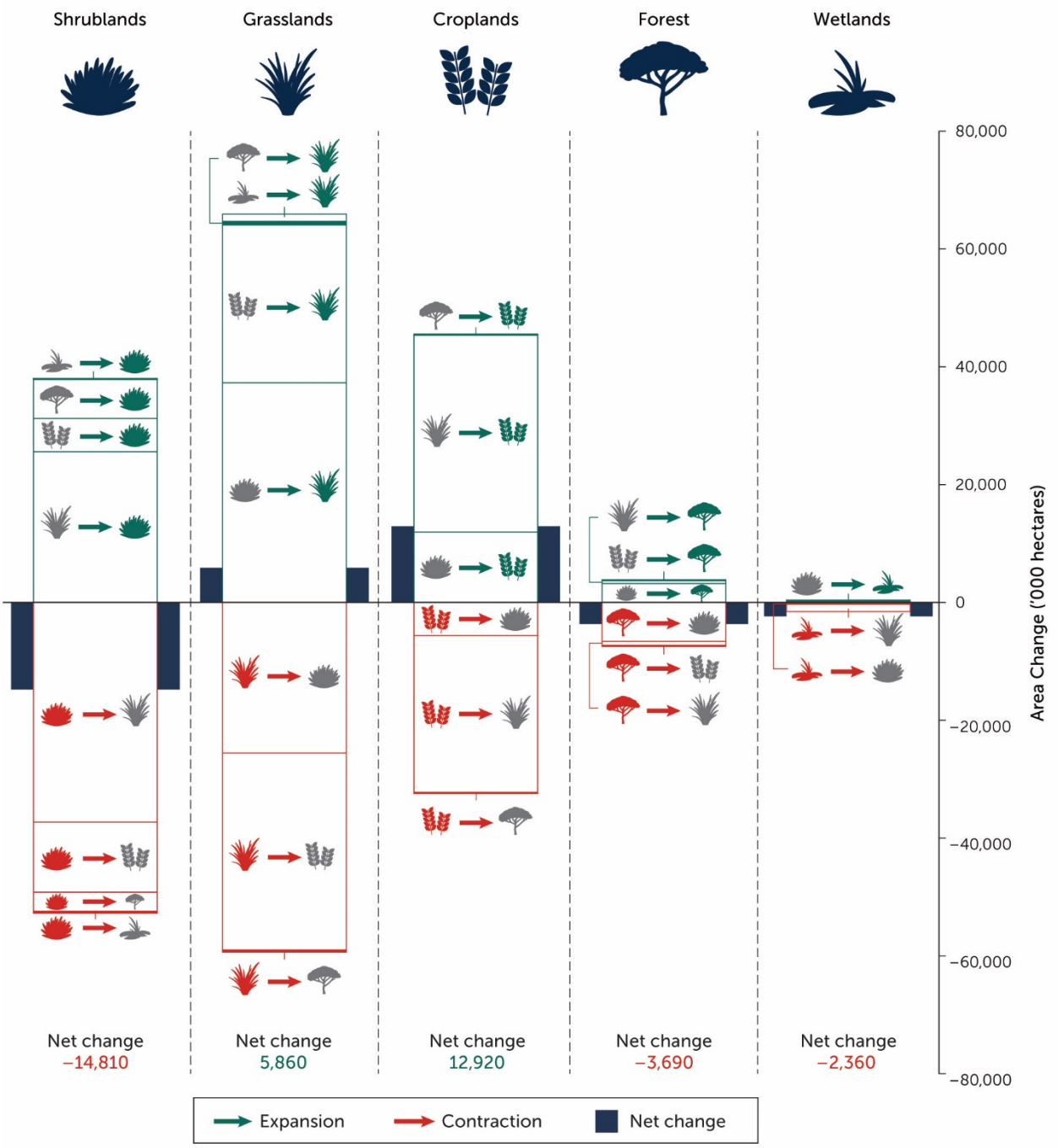
| Biome | Land cover (2017) | | | Land cover change (2015–2017) | | |
|---|---|---|---|---|---|---|
| | Total area (percent all biomes) | High erosion hazard areas | | Total area | High erosion hazard areas | |
| | | Slope > 20 percent | Riverbank | | Slope >20 percent | Riverbank |
| Forest | 78.07 (3.4%) | 0.00 | 0.00 | -3.69 | -1.73 | -0.06 |
| Shrublands | 563.97 (24.4%) | 45.40 | 4.28 | -14.81 | 1.02 | -0.18 |
| Grasslands | 999.37 (43.3%) | 18.67 | 8.59 | 5.86 | 0.10 | -0.05 |
| Croplands | 622.77 (27.0%) | 18.74 | 6.56 | 12.92 | 0.60 | 0.32 |
| Wetlands | 3.78 (0.2%) | 0.00 | 0.09 | -2.36 | 0.00 | -0.03 |
| Water | 32.59 (1.4%) | 0.00 | 0.00 | 2.25 | 0.00 | 0.00 |
| Bare | 0.00 (0.0%) | 0.00 | 0.00 | -0.37 | 0.00 | 0.00 |
| Urban | 7.36 (0.3%) | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 |

Note: We calculated values by using the annual MODIS Land Cover Type Product (Friedl et al. 2019) for 2015 through 2017, over the boundary area of the Shire River Basin. Biomes are defined according to the IGBP classification scheme. We selected high-slope areas by using the SRTM DEM (Farr et al. 2007), and riverbank areas are based on areas within a 15-meter buffer of the Shire River Basin hydrological network according to the HydroSHEDS data (Lehner et al. 2008).

These values reflect net area changes for each biome, signifying the relative magnitude of land conversion, whereas an identification of the underlying biome transitions over time provides information on whether erosivity is improving or worsening.[23] In Figure VII.1, we report the composition of these changes, which shows the total area transitioning between biomes over the study period. Positive (negative) values represent area gains (losses) over the 2015–2017 period, with the icons indicating from (into) which biome each land cover type transitioned. The largest absolute changes were from shrubland to grassland (37,000 hectares) and grassland to cropland (33,000 hectares), constituting more than 40 percent of all area that changed land cover type over the period. About 7,000 hectares of forest were converted to shrubland. This transition is a typical indicator of deforestation as land users did not replace forested area with a different biome (for example, grasslands or croplands). Deforested areas are likely to produce wood or charcoal for cooking. The blue bars denote a biome's net change in area over the period and correspond to values also presented in Table VII.1.

[23] For any location, a biome change over time does not necessarily indicate that the former biome no longer is present at all. Consider the example of deforestation. A location may have experienced sufficient forest degradation that the dominant biome is shrubland, as determined by the estimated canopy height and density. Note that the MODIS data product has a coarse resolution of 500 meters, with each pixel representing approximately 25 hectares. If the surface area encompassed by a single pixel comprises 12 hectares of forest and 13 hectares of shrubland, the pixel is most likely to be categorized as 'shrubland.' The actual land cover change over time for any individual pixel may therefore be more gradual than captured by discrete, land cover class changes.

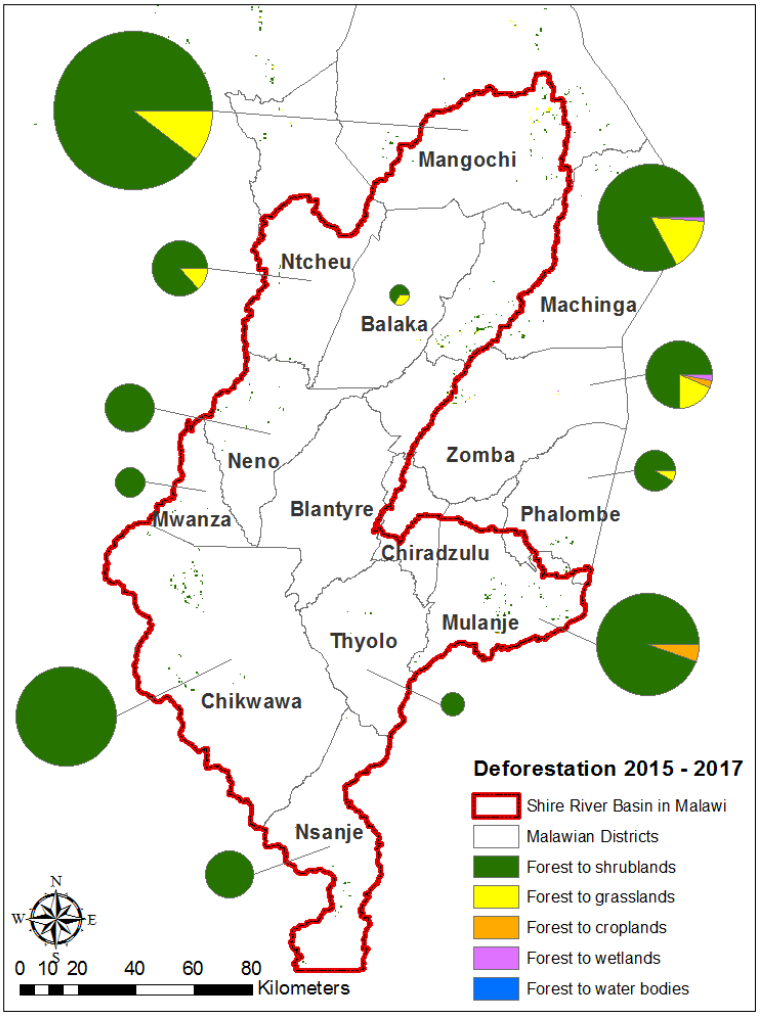
**Figure VII.1. Land cover change in the Shire River Basin, 2015–2017**




Note: We calculated values by using the annual MODIS Land Cover Type Product (Friedl et al. 2019) for 2015 through 2017, over the boundary area of the Shire River Basin (Lehner et al. 2008). These are gross areas of change and cannot be directly compared with Table VII.1. Biomes are defined according to the IGBP classification scheme (Table III.4). Select transitions that represent a small amount of total land cover change are not displayed, but their area extent is included in the net change values.

**Between 2015 and 2017, Mangochi, Machinga, Mulanje, and Chikwawa were the districts that experienced the most deforestation by total area.** In Figure VII.2, we decompose the net loss of 3,690 hectares of forest land in the Shire River Basin across districts for 2015 through 2017. Throughout the basin, the large share of deforested land was converted into shrubland, with grasslands the second most likely biome into which former forests transitioned. Extending our analysis back to 2000, the first year for which MODIS land cover data are available, we estimated that 10.1 percent of forest area throughout the Shire River Basin was lost by 2017, equal to a 0.63 percent annual deforestation rate. The deforestation rate for the Shire River Basin is high; for comparison, it is similar to deforestation rates for all of Malawi and for Mozambique but is greater than that for Tanzania and Zambia, with forest area losses of 8.3 and 6 percent, respectively, over 2000 through 2017.

**Figure VII.2. Deforestation in the Shire River Basin, 2015–2017**



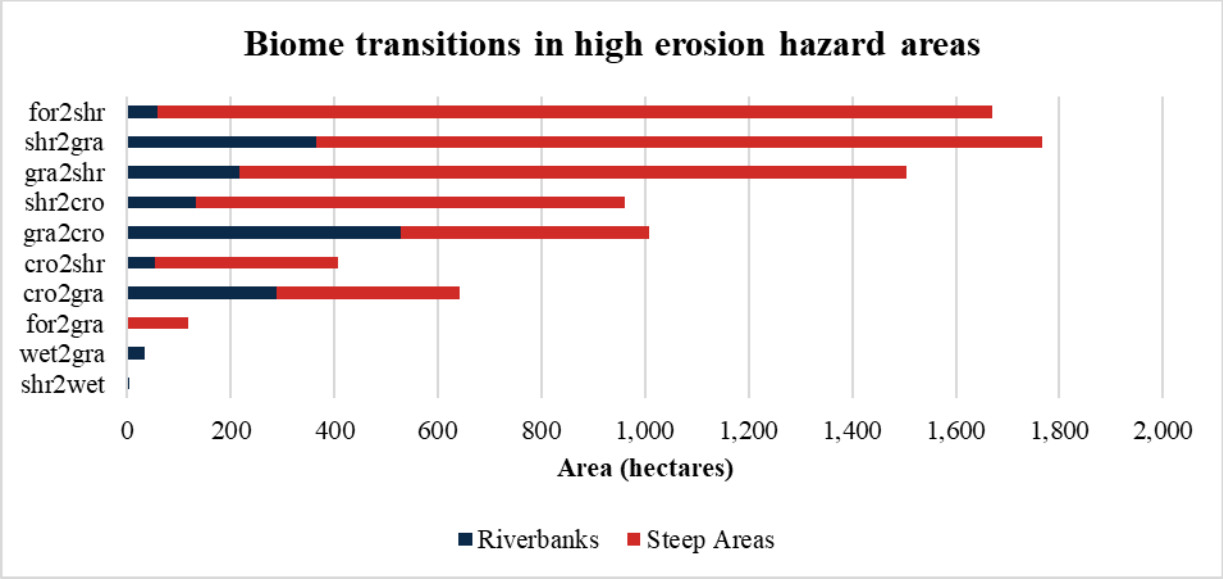

Note: We derived values by using the MODIS Land Cover Type Product (Friedl and Sulla-Menashe 2019) only for those portions of districts that are inside the Shire River Basin boundary (red). Pie sizes correspond to total area deforested, and pie slices indicate relative shares. For the purpose of interpretation, total deforestation in Mangochi was 4,079 hectares, and conversion to grasslands was 429 ha. Mwanza experienced 129 ha of forest loss.

**Areas with high-erosion risks have been converted to biomes that will further increase soil erosion, such as deforestation on steep terrain (slope exceeding 20 percent) and the expansion of croplands on riverbanks (within 15 meters of the water).** In the right pane of Table VII.1, we present the total area of high erosion hazard locations alongside the net changes. There is substantially more steep land than riverbank area, as seen in the middle pane. Consequently, each biome underwent less LCC in terms of absolute area in the high erosion hazard areas. Forest land in steep areas declined the most—by more than 1,700 hectares—while shrublands experienced the largest expansion at 1,000 hectares. Absolute LCC in riverbank areas was less pronounced, but conversion into croplands was the most important change.

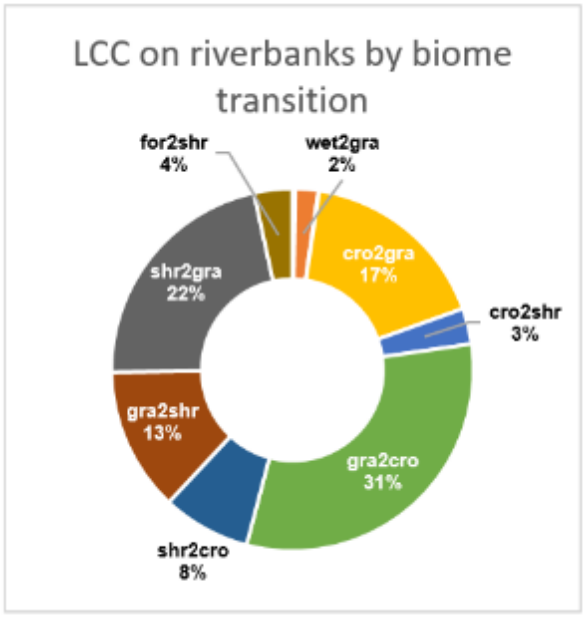
More than 31 percent of all LCC occurring on riverbanks was from grassland to cropland ("gra2crop"), which is close to double the area switching from cropland to grassland ("cro2gra"), as seen in Figure VII.3. This net expansion of cropland raises concerns about erosion risks because agriculture that does not follow sustainable land management practices leaves soil bare and more prone to erosion than is the case for grasslands. In steep areas, conversion of forests to shrublands accounted for 25 percent of all recorded LCC, with no significant offsetting conversion from other biomes into forest. Other major LCC sources for steep areas were largely self-compensating, such as the 1,400 hectares of shrublands converted into grasslands slightly exceeding the area converted in the opposite direction. This was not the case for the shrublands-to-croplands conversion, which more than doubled the reverse transition. In steep areas, as reported in Table VII.1, croplands underwent the second-largest expansion.

**Figure VII.3. LCC on high erosion hazard areas in the Shire River Basin, 2015–2017**

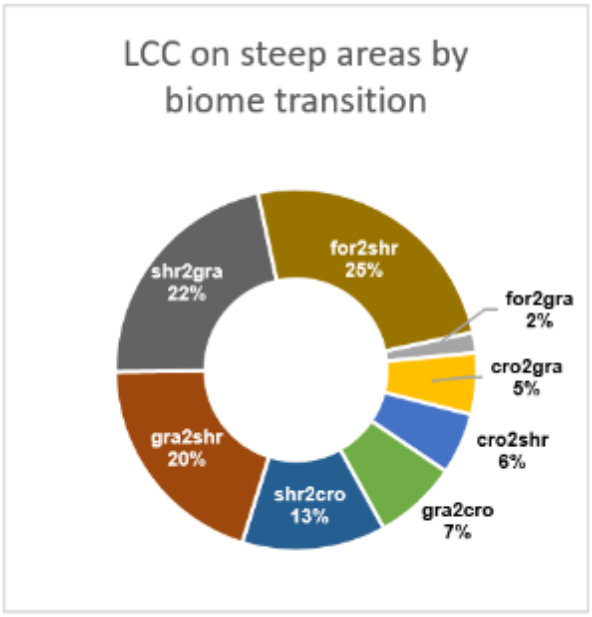
**A.**



**B.**




**C.**




Note: shr2wet = shrublands to wetlands; wet2gra = wetlands to grasslands; for2gra = forest to grasslands; cro2gra = cropland to grasslands; cro2shr = cropland to shrublands; gra2cro = grasslands to cropland; shr2cro = shrublands to cropland; gra2shr = grasslands to shrublands; for2shr = forest to shrublands. For the shrublands-to-grasslands transition, the share of riverbank LCC equals the share of high-slope LCC. We calculated values by using the annual MODIS Land Cover Type Product (Friedl et al. 2019) for 2015 through 2017 over the boundary area of the Shire River Basin. Biomes are defined according to the IGBP classification scheme. We selected high-slope areas by using the SRTM DEM (Farr et al. 2007) and riverbank areas are based on areas within a 15-meter buffer of the Shire River Basin hydrological network according to the HydroSHEDS data (Lehner et al. 2008). All other possible land use transitions that are not shown here recorded zero change for both high erosion hazard categories.

In summary, we found that nearly 7 percent of area in the Shire River Basin experienced some type of land conversion from 2015 through 2017. We observed no distinctive spatial pattern in LCC across the Upper, Middle, and Lower Shire areas. Reductions in forest area and increases in cropland indicated an overall increase in erosion vulnerability, which can potentially increase sediment loading unless SLM practices are expanded to newly cultivated lands. The analysis also suggested that areas with high erosion risks are undergoing conversion to biomes that further increase soil erosion, such as deforestation in steep terrain and the expansion of croplands on riverbanks. However, it is important to note that the total area experiencing LCC in the high-erosion risk areas is relatively small in comparison to the entire basin.

## B. SWAT model findings

As described in Section III.B, the SWAT model analysis uses several scenarios to model how sediment yields throughout the Shire River Basin might differ from baseline values. In the left panel of Figure VII.4, we visualize sediment yields, in tons per hectare per year, at the sub-basin level for the baseline scenario (historical land use and land cover as well as weather data). The right panel displays the growth in sedimentation from the baseline to a business-as-usual (BAU)

2030 scenario.[24,25] The sub-basins that would experience the largest increases in sedimentation rates, primarily driven by a continuation of current deforestation trends, are located in Phalombe and Mulanje districts. The greatest number of sub-basins in the Upper Shire River that under the BAU scenario would see sedimentation rate increases exceeding 0.2 tons/hectare-year are in Machinga and Zomba districts. Figures depicting the sediment yields under the BAU 2050 scenarios with climate change appear in Appendix Figure B.6. The spatial pattern of comparatively high sediment loads stayed relatively stable across all BAU scenarios, both without climate change (using historical weather) and with either severe (Representative Concentration Pathway [RCP] 8.5) or modest (RCP 2.6) climate change.

Under all scenarios, the sub-basins with highest sediment loads were located in Blantyre, Mulanje, and Phalombe districts. The zones with lowest sediment yields, stretching from north to south, were located in the riparian plain close to the Shire River's main channel. The two BAU 2050 scenarios that incorporate climate change projections predicted lower overall sediment yields, reflecting reduced precipitation compared to the baseline.[26,27] As an example, for Nkula, the SWAT model predicted that sedimentation inflows would decline by a substantial 37 percent under RCP 2.6 and by 12 percent under RCP 8.5 compared to a 2030 business-as-usual value with historic climate.

[24] Figure III.1 may be helpful in depicting the extent and location of the Shire River Basin relative to landmarks such as Malawi country borders, lakes, and the three dams of interest on the Shire River.

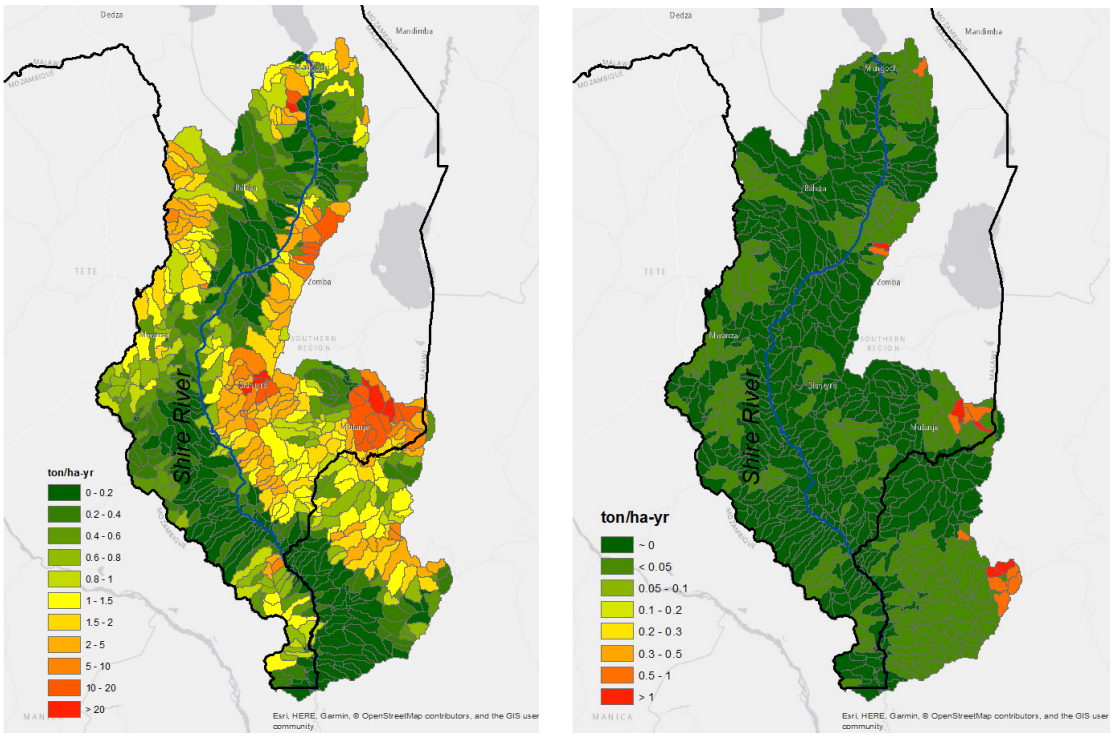
[25] In the BAU 2030 scenario, we extrapolated historical LCC changes to 2030, implicitly reflecting population growth and other developments.

[26] Further detail about the precipitation forecasts from the selected climate change scenarios appears in Appendix C.

[27] Figure A.6 depicts sediment yield estimates for the BAU 2050 scenarios.

**Figure VII.4. Sediment yields under the baseline and increases under the BAU 2030 scenario**

**(a) Baseline** **(b) BAU 2030 - Baseline**

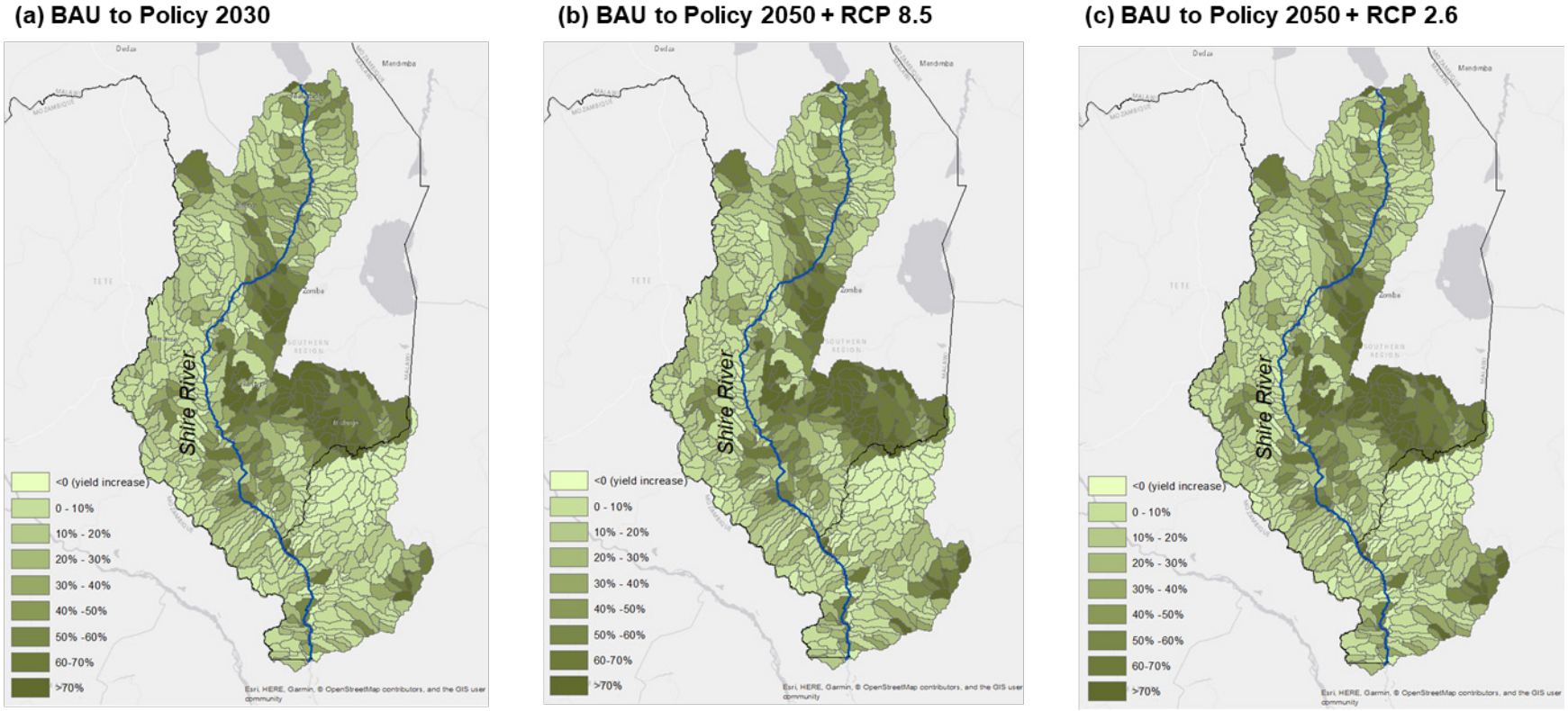



Note: We performed all calculations at the sub-basin level by using the SWAT Shire, Malawi model.

**We compared the policy scenario, with and without simulated climate change effects, to the BAU scenario, in which sustainable land management practices do not expand. We found that the majority of sub-basins would see relative reductions in sediment yields of 10 to 70 percent.** We present the relative changes in Figure VII.5, which shows that, with the exception of a few sub-basins where grassland would replace shrubland, the implementation of land conservation and land management practices aligned with the Government of Malawi's land restoration strategy would help reduce soil erosion and associated sediment yields. In some sub-basins, the magnitude of the reduction would exceed 70 percent. The spatial pattern of sediment reduction was similar across all policy scenarios. It is important to note that larger percentage reductions tended to occur in those sub-basins with higher sediment yields, indicating that reductions were also meaningful in absolute terms.

**Sediment inflows for the Nkula, Tedzani, and Kapichira reservoirs would decline substantially under the three policy scenarios, as shown in Table VII.2, indicating that the expansion of SLM practices throughout the Shire River Basin would contribute to an increase in hydropower capacity.** The sediment yield reduction for the Nkula and Tedzani reservoirs could be as high as 38 percent annually compared with BAU, with reductions at Kapichira estimated at about 30 percent over the two time horizons considered. The 2030 BAU scenario predicted slightly higher sedimentation rates than levels observed at baseline. In contrast, 2050 BAU scenarios with climate change showed lower sediment inflow rates than at

**Figure VII.5. Impact of land conservation and land management practices on soil erosion and sediment yield reduction**




Note: Positive values denote sediment yield reductions, which we calculated as the ratio of sediment yield under the policy scenario minus the BAU scenario sediment yield, divided by the BAU sediment yield. We performed all calculations at the sub-basin level by using the SWAT Shire, Malawi model. RCP 2.6 refers to the modest climate change scenario, and RCP 8.5 refers to the severe climate change scenario.

baseline, though reductions associated with the policy scenario were primarily attributable to the scenario's SLM practices rather than to climate change and the climate models' drier weather forecasts.[28]

**Table VII.2. Impact of land conservation and land management practices on sediment inflow of hydropower plant reservoirs (tons/year)**

| Scenario | | Nkula | Tedzani | Kapichira |
|---|---|---|---|---|
| **Baseline** | | **453** | **456** | **670** |
| 2030 | BAU | 460 | 463 | 679 |
| | Policy | 287 | 289 | 485 |
| | Percent change | -38% | -38% | -28% |
| 2050 + RCP 8.5 | BAU | 411 | 413 | 591 |
| | Policy | 253 | 254 | 415 |
| | Percent change | -38% | -38% | -30% |
| 2050 + RCP 2.6 | BAU | 335 | 337 | 473 |
| | Policy | 212 | 213 | 337 |
| | Percent change | -37% | -37% | -29% |

Note: All results are based on SWAT Shire, Malawi model simulations. RCP 2.6 refers to the modest climate change scenario, and RCP 8.5 refers to the severe climate change scenario.

Deposits of sediment inflows in reservoirs lead to a reduction in reservoir storage, which, in turn, affects the capacity of a hydroelectric plant to generate electricity. Drawing on the SWAT sediment modeling output, we further estimated, as shown in Table VII.3, savings in reservoir storage and hydroelectric production capacity that would result from changes in land use and land management practices. We estimated a decline in sediment deposition of approximately 9,000 to 13,000 cubic meters per year for Nkula reservoir, 5,000 to 6,000 cubic meters per year for Tedzani, and 30,000 to 43,000 cubic meters per year for Kapichira. The estimated savings in hydroelectric production capacity ranges from 0.4 to 0.8 MW per year for the three reservoirs under the three policy scenarios. These annual averted losses of reservoir storage capacity account for 0.5 to 0.7, 0.4 to 0.6, and 0.6 to 0.8 percent of the designed storage capacity of Nkula, Tedzani, and Kapichira, respectively, and would lead to annual savings in installed hydroelectric production capacity.[29] If Malawi were to adopt SLM practices indefinitely, the total effect of SLM on sedimentation would be the cumulative sum of the annual averted losses over the corresponding number of years. For example, for a 10-year window, each year in which

[28] The lower precipitation levels forecast under the selected climate models could potentially lead to lower reservoir levels, affecting hydropower production.

[29] In estimating the effects of different sedimentation volumes on hydroelectric production capacity, we assumed that the loss in capacity is proportional to the loss of reservoir storage. The relationship is certainly more complex and involves the direct effect of sediment's adverse effects on turbine equipment, which causes operational downtime. It also involves the management responses of dam operators to changes in sediment loads. The incorporation of such features into a model would require data not available to us.

Malawi achieves the 2030 policy scenario would avert losses of 0.8 MW of capacity at Nkula and therefore 8 MW more capacity at the end of the period relative to the BAU scenario. Equivalently, each year of SLM practices would also avert reservoir storage losses, which, in the case of Nkula, would sum to 10 to 14 percent of reservoir capacity over a 20-year period. The magnitudes of change for a single year may appear small, but the cumulative effects would aggregate to sizable magnitudes when assessed from a decadal perspective.

**Table VII.3. Impact of land conservation and land management on reservoir storage and hydroelectricity production capacity**

| | Savings in reservoir storage ($\times 10^3$ $m^3$/year) | | | Savings in hydroelectric production capacity (MW per year) | | | Combined savings in hydroelectric production capacity over 20 years for (MW) |
|---|---|---|---|---|---|---|---|
| | Nkula | Tedzani | Kapichira | Nkula | Tedzani | Kapichira | Combined power stations |
| 2030 | 13 | 6 | 43 | 0.8 | 0.5 | 0.5 | 36 |
| 2050 + RCP 8.5 | 12 | 6 | 39 | 0.7 | 0.5 | 0.5 | 34 |
| 2050 + RCP 2.6 | 9 | 5 | 30 | 0.6 | 0.4 | 0.4 | 28 |

Note: Calculated savings in reservoir storage used constant trap efficiencies of 10 percent for Nkula, 5 percent for Tedzani, and 30 percent for Kapichira (FICHTNER 2014). We assumed that the loss in hydroelectric production capacity caused by per cubic meter of reservoir storage reduction was constant (Borji 2013). We calculated the hydroelectric production capacity per cubic meter of reservoir storage by using hydropower installed capacity and initial storage of the three reservoirs (FICHTNER 2014). RCP 2.6 refers to the modest climate change scenario, and RCP 8.5 refers to the severe climate change scenario. All values presented are relative to respective BAU scenarios.

In summary, the SWAT model assessment offers three important findings. First, a policy scenario that expands sustainable land management practices throughout the Shire River Basin would likely lead to widespread sediment reductions, with only a small number of sub-basins experiencing sediment increases. When compared to historical data, the policy scenario is forecast to result in a reduction in sediment inflow into the Nkula, Tedzani, and Kapichira reservoirs. Second, both the severe (RCP 8.5) and modest climate change (RCP 2.6) scenarios would lead to overall sediment inflow reductions at the three reservoirs, under either the BAU or policy scenario. Finally, we estimated the effects of the policy scenario with and without climate change on hydropower production capacity. We found that SLM practices would yield a not insignificant annual increase in production capacity compared to the BAU scenario, which would add up to large gains over the long run if SLM practices were adopted indefinitely. We estimated that, as opposed to the BAU scenario, the policy scenario's sustained SLM practices and rate of land cover change over a 20-year period could help avoid total hydroelectric production capacity losses at the Nkula, Tedzani, and Kapichira power stations by between 28 and 36 MW.

## C. Overall performance evaluation

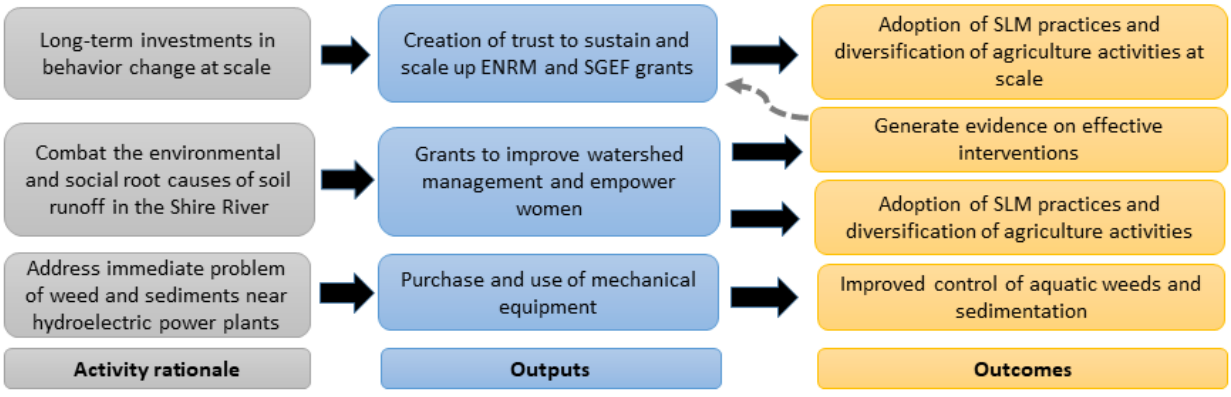
To answer research questions on overall project implementation, outcomes, and sustainability, we synthesized activity level-findings to conduct a performance evaluation of the ENRM project. We first assessed implementation fidelity and changes against the project logic model's planned

inputs and expected outputs. We then used the project logic model, Indicator Tracking Table data, and interviews with MCA-Malawi and MCC staff to assess higher-level project outcomes. Finally, we synthesized sustainability findings from each activity evaluation to assess overall project sustainability by considering stakeholder commitment, technical capacity, financial resource availability, and political support.

## 1. Implementation

As illustrated in Figure VII.6, the ENRM project aimed to address three main issues that resulted in low utilization of the hydropower plants: overflow of weeds and sediment at or near the power plants, underlying environmental and social causes of soil runoff in high-priority communities, and long-run planning to effect land management behavior change at scale in the Shire River Basin. The ENRM project generally adhered to its planned implementation (inputs) to address the problems identified in the program logic. However, the project also exhibited several key departures from its plan. Critically, because of delays in equipment procurement, MCA-Malawi canceled procurement of the planned dredger for the Nkula power station. Thereafter, the project did not provide the site with support to reduce sedimentation. That absence of support, in turn, affected nearby Tedzani, which was expected to benefit from the dredging at Nkula. The procurement delays rippled through other parts of the WSM activity as the Kapichira dredger and sediment disposal area were not yet operational at the end of the compact. The project's inability to fully implement the WSM activity as planned compromised a key pillar of the program logic—a response to the immediate sedimentation problem affecting hydropower generation. We found that the WSM activity has yet to improve control of aquatic weeds and sedimentation (activity output).

**Figure VII.6. ENRM project logic: Inputs and outputs**




The environmental trust's focus on sustainability was a central pillar of the project logic, but creation of the trust experienced significant delays. This was partly because of a poorly performing implementer and partly because of the evolution of the key financing mechanism away from an endowment approach and toward a composite approach with a PES and donor funding. At the close of the compact, the trust was legally established but had no office space, staff, or a clear source of funding. As a result, the trust was unable to achieve its planned output of scaling up support for the adoption of SLM practices and diversifying agriculture activities in

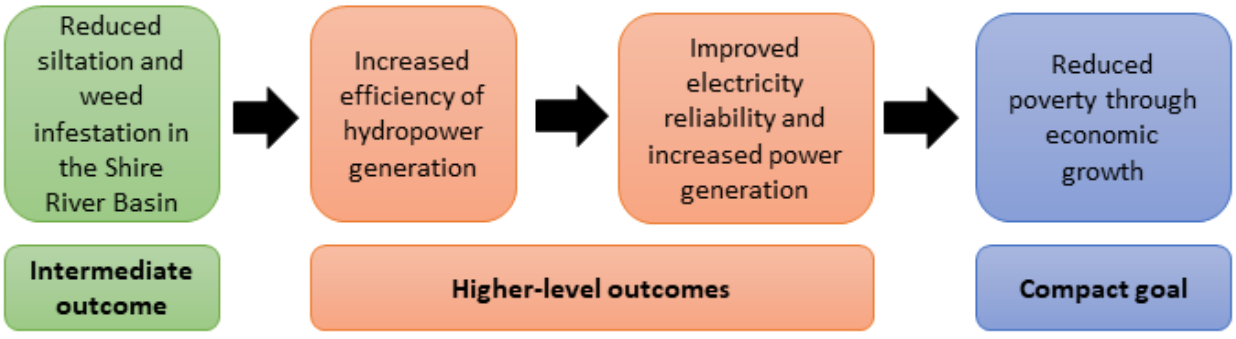
the Shire River Basin. In fact, the trust's implementation challenges substantially reduced the likelihood that project activities would be sustained post-compact.

MCA-Malawi was able to implement the grant facility successfully, providing grants to 11 organizations to address the fundamental environmental and social causes of poor land management in high-priority areas of the Shire River Basin. Initially, MCA-Malawi and MCC envisioned that several grantees would implement only SGEF or ENRM activities and work in overlapping areas; instead, all grantees ended up integrating ENRM and SGEF activities and generally operated in separate catchment areas. Grant staff reported on the positive benefits of this approach, even though some grantees had more experience with one type of activity or another. MCA-Malawi did face a challenge in generating useful evidence as to the effectiveness of grant activities, an important consideration for the trust or future implementers and donors. MCC and MCA-Malawi were able to report on only a small set of aggregated indicators because of concerns about the quality of grantee-reported monitoring data and MCA-Malawi's capacity to conduct proper oversight of 11 grantees over an expansive intervention area. Unfortunately, grantees were unable to report on key measures such as adoption rates of SLM practices. Through our case study analysis of five grants, however, we found that beneficiaries reported high adoption rates of SLM practices (Velyvis et al. 2019).

## 2. Intermediate and higher-level project outcomes

Beyond the inputs and outputs assessed above, the ENRM project intended to achieve higher-level outcomes as illustrated in Figure VII.7, such as a reduction in siltation and weed infestation in the Shire River Basin. The improved conditions, in turn, would increase the efficiency and reliability of hydropower generation, resulting in reduced poverty through equitable and sustained economic growth in Malawi.

**Figure VII.7. ENRM project logic: Outcomes and compact goal**




It is too early, however, to assess high-level project outcomes given that the ENRM project has not yet achieved its main intermediate outcome (and the project's stated objective) of reduced siltation and weed infestation (MCC 2013). Sediment dredging had not begun at Kapichira, a head pond that is almost three-quarters full of sediment. The new weed harvesting equipment at the Liwonde barrage was operated occasionally as it tended to get used more heavily in the rainy season when weeds break loose and travel downstream, and it would only have been put into operation fully during the first rainy season starting in December 2018, after the compact

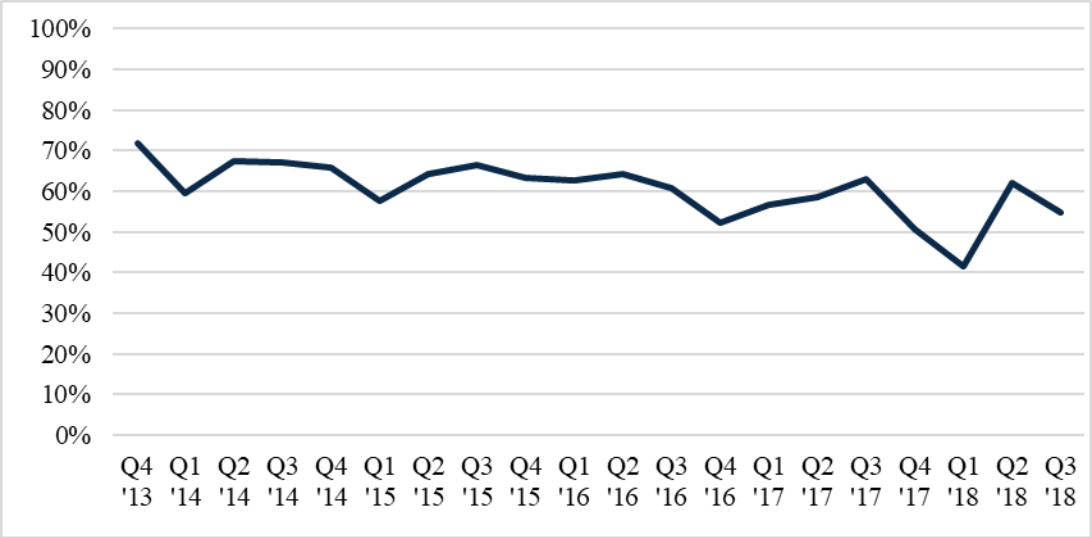
officially closed. Even though implementation of the ENRM and SGEF grant activities took place according to schedule, they affected only a relatively small area of the Shire River Basin through shorter-term interventions. MCC and MCA-Malawi staff did not expect the grants to have a discernible effect on sediment runoff and weed growth. Instead, the grants served as a pilot for the environmental trust, allowing the trust to bring effective grant interventions to scale. Even so, the trust is not yet operational, and it is questionable as to if and when such a scale-up will occur.

In view of the above outcomes and conditions, we expected no change in higher-level outcomes and the achievement of the compact's ultimate goals at the time of our assessment, a viewpoint echoed by project stakeholders and reinforced by the data collected to monitor compact implementation. We found overall that hydroelectric power plant utilization did not vary much during the compact (Figure VII.8). It generally vacillated between 50 and 70 percent of overall capacity, with a flat trend line over the course of the compact. In other words, as expected, we found no change in this higher-level outcome at the time of the assessment. In the final quarter of the compact, average plant utilization was a disappointing 55 percent, much lower than the targeted 90 percent, and this occurred during the dry season when weeds and sediment should have been less of a problem for power plant operation. EGENCO still cited low water levels, plant maintenance, and high levels of weeds and sedimentation as reasons for the low utilization rate. During the same quarter, EGENCO reported that weeds and sediment caused 9,965 megawatt hours (MWh) not to be produced at Tedzani and 130 MWh not to be produced at Kapichira. Nkula did not report that it was offline because of weeds and silt (MCC 2019).[30]

MCA-Malawi and MCC staff members were optimistic that the ENRM project would have a positive impact once all activities were fully implemented. Staff pointed to the dredger at Kapichira in particular as an intervention that could make an immediate difference for power plant utilization. Plant utilization at Kapichira was about only 60 percent during the third quarter of 2018.

[30] For the final evaluation report, we expect to provide more conclusive evidence on the relative contributions of dredging and SLM to increased operation of hydroelectric power plants. Several factors drive plant utilization rates, including the availability of dredging equipment, reservoir water levels and precipitation, and turbine equipment quality, among others.

**Figure VII.8. Overall hydroelectric power plant utilization by quarter: 2013–2018**




Source: Malawi compact Indicator Tracking Table (MCC 2019).

Note: Figure shows the quarterly average of the share of power generation out of the total possible power generation based on power plant capacity at Nkula, Tedzani, and Kapichira. The Nkula A power plant was shut down for refurbishment for one year from third-quarter 2017 through second-quarter 2018 and therefore had a 0 percent utilization rate during that time.

We have not identified any unintended consequences of project activities. MCC staff expressed concern that improper sediment disposal at Kapichira could have adverse environmental consequences. We will look into that issue in the final evaluation report once dredging at Kapichira commences. MCA-Malawi staff emphasized the importance of a holistic approach to the energy sector in order to ensure a meaningful impact. As one staff member summarized, "We have to manage the environment, we have the reforms but also the system. We have to continue to improve the grid but the most important is the generation, we don't have the capacity, demand is too huge, two, three times higher than the capacity" (MCA-3). Whether the ENRM project in particular and the Malawi compact in general effectively address energy shortages in Malawi remains to be seen.

## D. Prospects for project sustainability

We now turn to assessing overall project sustainability by synthesizing findings from our sustainability analyses at the activity level relative to stakeholder commitment, technical capacity, financial resources, and political support.

**Stakeholder commitment.** All key stakeholders connected to the ENRM project— EGENCO, ESCOM, GoM, community leaders, and local government officials—agreed that farming decisions and deforestation in the Shire River Basin have led to an increase in erosion and sediment runoff into the river. Stakeholders identified SLM as a critical component in addressing these problems. Yet, even though stakeholders recognized the importance of SLM, they faced many competing priorities that limited their capacity to address sediment runoff and weed growth in the Shire. EGENCO and ESCOM were concerned about the immediate need to ensure electricity reliability, including the procurement of diesel generators. Even though SLM offers

potential, its benefits will not emerge immediately. It will take time to improve power generation through reduced soil runoff, yet load shedding is already occurring regularly. The GoM was dealing with a host of issues even as several actors turned their attention to the May 2019 presidential and parliamentary elections. In addition to SLM, community leaders are also trying to address endemic poverty within villages.

**Technical capacity.** EGENCO appeared to have the needed contracts in place and has trained a sufficient cadre of staff to operationalize dredging operations at Kapichira and to continue with weed removal at the Liwonde barrage. It is unclear, however, if EGENCO has engaged the appropriate technical experts needed to complete its five-year capital dredging plan at Kapichira, which requires continuous operation of the dredger. More worrisome is the technical capacity available to establish the environmental trust. The trust needs experienced and engaged leaders to see the activity through to completion. MMDT was expected to help operationalize the trust and work with its board of directors, but it is currently unknown who will assume key leadership roles. As a result, the trust has a leadership vacuum that could compromise its prospects for sustaining project activities.

**Financial resource availability.** Even though the compact has closed and other donors are involved in competing projects in Malawi, the GoM has committed funds to complete project implementation post-compact. MCC's compact close-out letter details GoM's financial commitments of $8.7 million to complete, among other activities, the establishment of MMDT for one year as the implementing agency. For the ENRM project, the GoM has agreed to oversee completion of the sediment disposal area in Kapichira and the initiation of capital dredging of the head pond. Beyond funding earmarked for MMDT and compact close-out tasks, the environmental trust requires substantial financial resources to become operational. While EGENCO signed a one-year agreement with the trust to provide initial funding, the amount is lower than what MERA approved in the environmental levy. ESCOM has not provided a formalized, written commitment to fund the trust. The trust will need to conduct considerable fundraising to become financially viable.

**Political support.** In addition to financial resources, the GoM provides critical political support to sustain ENRM project activities, particularly dredging in Kapichira and establishing the environmental trust. The creation of MMDT provides early evidence as to the government's commitment. Further, MCC recently announced that it had approved the development of a second compact with Malawi. The second compact will not be in the energy sector, but it may give MCC important political leverage to ensure completion of the first compact's activities. MCC is also demonstrating its continued interest and engagement in Malawi, bolstering the government's support for completion of compact activities.

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# VIII. CONCLUSION AND NEXT STEPS FOR THE EVALUATION

Our evaluation of the ENRM project included separate studies of the WSM activity, the grant facility, and the environmental trust, along with an overall project assessment. Further, our companion report (Velyvis et al. 2019) analyzed five ENRM and SGEF grants in depth through a case study approach. In Table VIII.1, we highlight our key interim findings for each research question addressed in this report.

Overall, we find that contractor selection and oversight was a substantial implementation barrier for both the WSM and trust activities. Even though the WSM activity ultimately procured less equipment than planned, the dredger at Kapichira could still significantly improve the efficiency of hydropower generation at that plant. However, given the implementation delays, it is up to EGENCO and MMDT to complete the sediment disposal area and ensure dredging gets started. The grant facility succeeded in identifying qualified grantees that were able to execute well-implemented ENRM and SGEF programming in high-priority areas of the Shire River Basin that contribute heavily to sediment run-off issues. Nonetheless, the 11 grants implemented under the grant facility (as planned) lacked the scale to produce a measurable effect on hydropower generation. Through our SWAT analysis, we found that scaling up such interventions under a GoM land cover change policy goal could reduce sediment inflow for the Nkula, Tedzani, and Kapichira reservoirs by 30 to 40 percent compared to a business-as-usual scenario absent such interventions.

The environmental trust was the project's pivotal sustainability mechanism for achieving longer-run reductions in sediment yield. Yet, by the end of the compact, the trust existed only on paper and without full-time staff, dedicated office space, an official bank account, and clear and committed financing. There is substantial risk that the trust may not evolve into the large grant-making organization envisioned by the compact. Without ongoing activities to improve land management practices throughout the Shire River Basin, communities are unlikely to change their behavior in a way that would have long-run positive environmental effects. The WSM equipment can address the immediate technical problems at Kapichira and the Liwonde barrage, but the effort will be ineffective without a continued focus on the fundamental environmental causes of sediment runoff and weed growth. The ultimate effect of the WSM activity is also limited by MCA-Malawi's failure to procure a dredger at Nkula, which was also intended to address the sediment problem at nearby Tedzani. Although the ENRM project was well designed to address both short-term technical problems and longer-run challenges requiring communitywide behavior change, we will have to wait until the evaluation's final phase to assess whether the activities will be sustained beyond the compact to achieve the project's intended objectives of increasing hydropower generation efficiency and electricity reliability.

## Table VIII.1. ENRM Project evaluation summary

| Main research questions | Key interim findings |
|---|---|
| **WSM activity evaluation** | |
| 1. How was the activity implemented? | • Equipment delivery was significantly delayed because of poor contractor selection and performance, leading to cancellation of the procurement of a dredger for Nkula.<br>• EGENCO proved to be a supportive partner for activity implementation and was engaged and invested in equipment procurement and training, but, as of the close of the compact, the newly procured equipment had not yet been put into operation. |
| 2. How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity? | • EGENCO has developed equipment sustainability plans that call for stocking sufficient spare parts, training appropriate staff, and conducting regular service checks.<br>• Whether the equipment is maintained and continues to be operable depends on stakeholder commitment and resource availability. |
| 3. What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity? | • EGENCO and the GoM have committed funds to implement the WSM activity, but EGENCO faces substantial risks in achieving its capital dredging plan for Kapichira and properly disposing of the dredged sediments. |
| **Grant facility evaluation** | |
| 1. How was the grant facility activity implemented? | • The facility was well designed to allow for experimentation in order to identify effective SLM interventions. However, it was also constrained by a three-year intervention window and cost-reimbursement contracts that slowed some aspects of grant implementation.<br>• MCA-Malawi conducted a thorough and detailed process to identify the most qualified grant applicants, but, at times, it relied on subjective criteria and undocumented decisions.<br>• MCA-Malawi was able to conduct rigorous financial and programmatic grant oversight, but, particularly on the programmatic side, staff members were overwhelmed by the volume of work in the absence of sufficient resources, a consequence of the grant facility structure.<br>• Most of the villages selected by grantees were located in or near prioritized areas, based on environmental features identified in the Middle and Upper Shire Baseline Assessments and Action Plan.<br>• Despite the benefits of and drawbacks to many alternative grant facility structures, MCA-Malawi could have designed its grant facility to benefit from greater synergies with the planned environmental trust. |

| Main research questions | Key interim findings |
|---|---|
| 2. Which objectives specified in the grant facility manual were achieved by the grant facility and which were not, and why? | • When soliciting and approving grant proposals, the grant facility followed the main recommendations in the baseline environmental reports in terms of activity type and location.<br>• The grant facility exceeded the output targets it tracked, including the number of trees survived, the number of leaders trained in ENRM, and the number of operational REFLECT circles and VSLs. However, the grant facility did not have the resources, capacity, or a plan to obtain high quality data on important measures such as the number of farmers adopting SLM practices. Many grants also did not cover the entire agricultural value chain.<br>• The grant facility succeeded in pushing all grantees to integrate ENRM and SGEF activities—a novel approach—though grantees adjusted their activity mix depending on their technical expertise. Some grantees focused more heavily on ENRM activities while others concentrated more on SGEF activities.<br>• The grant facility supported activity scale-up and raised awareness about the seriousness of the soil erosion problem by generating evidence as to activity effectiveness, creating linkages with other donors and government stakeholders. However, it is too early to tell if these outcomes will be sustained given that the trust is not yet operational and the compact has closed. |
| **Environmental trust evaluation** | |
| 1. What implementation factors supported or hindered establishment of the trust? | • Early lack of agreements between MCC and MCA-Malawi as to how to structure the trust and grant facility delayed trust implementation. That factor, along with poor contractor implementation, left too little time for successfully establishing and operationalizing the trust prior to the close of the compact.<br>• The trust has a functional board of directors made up of the key stakeholders for land management in the Shire River Basin. However, board members have limited availability for their tasks and need permanent technical staff to push the trust forward. After we completed data collection for this report, the trust identified a board member to serve as trust coordinator<br>• MERA approved an increase in the environmental management levy for EGNECO, and MCC reported a deal in principle whereby EGENCO and ESCOM will pay for initial trust operations through the electricity levy. After we completed data collection for this report, EGENCO signed a one-year agreement with the trust to provide funding at a level lower than in the approved levy. ESCOM has not provided a formalized, written commitment to fund the trust. |
| 2. To what extent is the trust on track to reach administrative and operational sustainability? | • It is uncertain if the trust will be successfully launched and sustained in the coming years. It has key supporters in Malawi and prospects for sufficient capital, but it will need a strong champion outside of MCA-Malawi and MCC if it is to advance from an idea to reality. Leadership is a key factor for the trust's success. |

| Main research questions | Key interim findings |
|---|---|
| **ENRM project evaluation** | |
| 1. How has land use along the Shire River changed during the ENRM project? | • Close to 7 percent of land area in the Shire River Basin experienced land cover change between 2015 and 2017, with overall trends suggesting deforestation and cropland expansion. A large share of deforested area is located in high-slope areas, and agricultural land is encroaching onto riverbanks. The evidence suggests that areas facing high erosion risk are being converted to biomes that exacerbate soil erosion. |
| 2. If the project activities were expanded throughout the area, how would the activities affect sedimentation in the Shire River based on alternative modeling scenarios? | • We modeled a policy scenario consistent with GoM's land restoration targets and found that the adoption of sustainable land management practices would reduce sediment inflow for the Nkula, Tedzani, and Kapichira reservoirs by 30 to 40 percent relative to a business-as-usual scenario. If these practices were adopted continuously for 20 years, the three plants would avert total losses of between 28 and 36 MW of hydroelectric production capacity due to sedimentation at the end of the period as compared to the business-as-usual scenario. |
| 3. Which implementation factors supported or hindered the effectiveness of the ENRM project overall? | • All activities were aligned with the project's theory of change; however, MCA-Malawi, with MCC's support, was implementing an ambitious set of activities for a five-year compact and had limited experience in procuring dredging equipment and setting up a trust in Malawi.<br>• MCA-Malawi, with MCC's substantial support, demonstrated strong implementation flexibility as they adjusted to conditions on the ground, particularly poor contractor performance. |
| 4. Did the ENRM Project achieve its targeted intermediate and final outcomes and contribute to higher-level compact objectives? Why or why not? | • As the project has yet to effect a reduction in weeds and sediment in the Shire River, it is too early to assess higher-level outcomes on power generation and reliability. In fact, in the final quarter of the compact, average power plant utilization was a disappointing 55 percent, well below the compact target of 90 percent. |
| 5. What are stakeholders' perceptions of the sustainability of outcomes achieved under the ENRM project, and why? | • At the close of the compact, key stakeholders remained committed to project activities. The GoM has committed resources to see activities through to completion, but it is too early to tell if project outputs and outcomes will be sustained. |

Note: Key findings were drawn from summary findings reported in each results' chapter.

Overall, we found that the ENRM project achieved many of its intended outputs and that its structure aligned with the project's theory of change. At the same time, with the compact only closing in September 2018 and the outputs for the WSM and trust activities yet to be fully operational, it is too early to assess overall project performance. We have several unanswered questions that we will examine in the final evaluation report, such as the following:

- Did EGENCO complete the sediment disposal area and successfully operationalize its plan for capital dredging of the head pond at Kapichira?

- Is the dredging at Kapichira producing the intended effect of restoring active storage at the head pond and increasing hydropower plant utilization? [31]
- Is EGENCO able to harvest more weeds with the new equipment at Liwonde? Is EGENCO able to maintain the equipment? How has weed harvesting affected plant utilization downstream?
- Among the ENRM and SGEF grant beneficiaries, did they continue to adopt SLM practices, and did those practices spread within the community? Did communities maintain and expand nascent behavioral changes in women's empowerment?
- Did the environmental trust become operational, including establishing an office, solidifying a reliable funding stream, hiring staff, soliciting proposals, and providing grants?
- How does our model of sedimentation in the Shire River Basin change with updated data on land use planning, weather patterns, and SLM adoption rates?
- Once fully implemented, was the ENRM project able to improve hydropower generation?

We intend to collect a second round of qualitative and administrative data in 2020 to address these questions. We will interview ENRM and SGEF grant beneficiaries, staff and board members of the environmental trust, and EGENCO power plant operators. We will also collect updated data from EGENCO on power plant operations as well as on climate, water quality, and land cover in order to undertake geospatial analysis and modeling. The final evaluation report, to be issued in mid-2021, will provide evidence as to the effectiveness of a holistic approach to improving hydropower generation and the types of interventions that can potentially effect behavior change for land management practices.

[31] This question helps address additional research questions on WSM equipment performance for the final evaluation report including:

- Did the equipment purchased perform as expected in terms of the quantities of sediment dredged and weeds harvested?
- To what extent did the activity restore active storage at the hydropower plants during the compact and after it ended?
- Did the new weed harvesters and dredgers affect power plant operations during the compact and after it ended?
- To what extent did the equipment change power generation?
- How did the use of the equipment and related improvements vary by hydropower plant?

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# Appendix A:

# Additional information on grant facility grantees and selection process

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## Table A.1. Overview of approved ENRM and SGEF grantees

| Implementing organization | Project title (grant size) | Subcatchment (district) and intervention villages | | Summary of activities |
|---|---|---|---|---|
| Action Aid Malawi (AAM)[a, b] | Invigorating Gender-Inclusive Environment and Natural Resource Management ($502,503) | Mwetang'ombe—Lisungwi (Neno) in 32 villages (three TAs) | ENRM | I. Identify lead farmers to carry out mobilization campaigns on woodlot management and other sustainable farming practices<br>II. Conduct trainings in sustainable land use practices, including tree planting, vetiver grass planting, and fruit tree propagation |
| | | | SGEF | I. Conduct trainings in business management; conduct literacy and gender-equitable ENRM classes<br>II. Establish village savings and loan (VSL) groups to support alternative income-generating activities<br>III. Conduct meetings to sensitize community members to gender equality<br>IV. Establish adult literacy classes |
| Assemblies of God Care (AG CARE)[b] | Enhancing Livelihoods and Resilience of Households in Lingamasa Catchment Area of Upper Shire Basin ($515,439) | Upper and lower Lingamasa (Mangochi) in 20 villages (one TA) | ENRM | I. Sensitize communities to environmental degradation<br>II. Distribute and plant tree seedlings and sweet potato vines |
| | | | SGEF | I. Conduct training in leadership and sustainable land management<br>II. Establish adult literacy classes |
| Catholic Commission for Justice and Peace (CCJP)[a] | Empowering of Communities in the Upper Shire River for Power Generation ($362,084) | Upper Lingamasa (Mangochi) in 31 villages (one TA) | ENRM | I. Conduct trainings in sustainable land use practices, including tree planting, fruit propagation, and vetiver grass planting |
| | | | SGEF | I. Lobby local leaders to increase women's involvement in agricultural decision making<br>II. Hold community trainings for women in leadership, business and marketing skills, livestock production, beekeeping, and household planning and budgeting<br>III. Establish VSL groups and adult literacy and mathematics schools<br>IV. Conduct trainings to sensitize community members to gender equality |

| Implementing organization | Project title (grant size) | Subcatchment (district) and intervention villages | | Summary of activities |
|---|---|---|---|---|
| Circle for Integrated Community Development (CICOD) | Machinga-Based Shire River Catchment Biodiversity Conservation and Management Project ($482,918) | Machinga-Likwenu River Watershed (Machinga) in 45 villages (two TAs) | ENRM | I. Train village committees to oversee and lead ENRM activities<br>II. Distribute vetiver grass and construct check dams, box ridges, and contour ridges to slow the speed of water runoff<br>III. Plant trees, establish communal woodlots, produce manure, and distribute seeds for crop diversification<br>IV. Provide trainings in forest reserve monitoring, business management, beekeeping, and livestock husbandry |
| | | | SGEF | I. Conduct trainings to sensitize community members to gender equality<br>II. Provide trainings in women's empowerment<br>III. Establish VSL groups and leaders to support alternative income-generating activities<br>IV. Establish adult literacy classes |
| Foundation for Irrigation and Sustainable Development (FISD) | Integrated Approaches to Natural Resources Management and Conservation for Sustainable Hydropower Project ($718,201) | Lunzu—Linjizi (Blantyre) in 113 villages two TAs) | ENRM | I. Provide trainings in sustainable land use practices, including tree planting, forest management, manure and mulch production, and gully and swale construction<br>II. Conduct trainings in business management and leadership<br>III. Advocate for sustainable land use practices at village government meetings<br>IV. Establish a solar-powered irrigation scheme |
| | | | SGEF | I. Conduct meetings to sensitize community members to gender equality<br>II. Establish VSL groups to support alternative income-generating activities |
| Self Help Africa (SHA) | Shire Basin Sustainable Natural Resources Management Social Enhancement Project ($607,147) | Mid Nkasi (Balaka) in 127 villages (three TAs) | ENRM | I. Conduct trainings in sustainable land use practices, including box ridge, check dam, contour ridge, and marker construction; pit planting; agroforestry; manure production; and livestock husbandry<br>II. Distribute and plant tree seedlings and pigeon peas to increase income and decrease runoff |
| | | | SGEF | I. Conduct meetings to sensitize community members to gender equality<br>II. Establish VSL groups to support alternative income-generating activities<br>III. Conduct training with women in business management and marketing |
| The Hunger Project (THP) | Titukuke ndi Chilengedwe ndi Magetsi/Growth through Environment and Electricity ($540,050) | Mwetang'ombe—Lisungwi (Neno) in 45 villages (one TA) | ENRM | I. Conduct training for community members in sustainable land use practices, including gardening, tree planting, fruit propagation, gully reclamation, and forest management<br>II. Establish and train Village Natural Resource Management Committees (VNRMC) |
| | | | SGEF | I. Establish VSL groups to support alternative income-generating activities<br>II. Identify and educate trainers of trainers (ToT) and local leaders in female empowerment issues<br>III. Identify and educate ToT on business and financial management to educate VSLs |

| Implementing organization | Project title (grant size) | Subcatchment (district) and intervention villages | | Summary of activities |
|---|---|---|---|---|
| Training Support for Partners (TSP) | Strengthening Community Participation in Sustainable Land and Forest Management in the Middle Shire River Basin ($438,701) | Upper Rivirivi (Ntcheu) in 107 villages (two TAs) | ENRM | I. Conduct trainings to sensitize community to relationship between ENRM and power generation<br>II. Conduct training in business management, including beekeeping<br>III. Provide training in SLM practices, including tree planting, contour ridge construction, vetiver grass planting, climate-smart technologies, and clan-based forest management |
| | | | SGEF | I. Establish VSL groups to support alternative income-generating activities<br>II. Establish adult and child literacy classes<br>III. Conduct meetings to sensitize community members to gender equality<br>IV. Train women and local leaders in advocacy and lobbying |
| United Purpose (formerly Concern Universal) | Improving Catchment and Natural Resource Management for Sustainable Livelihoods ($836,064) | Upper Chimwalira and Upper Chilanga (Balaka) in 72 villages (three TAs) | ENRM | I. Provide seeds for crop diversification<br>II. Conduct trainings in SLM practices, including crop diversification, tree planting, and vetiver grass planting |
| | | | SGEF | I. Establish adult literacy classes<br>II. Conduct leadership trainings<br>III. Conduct meetings to sensitize community members to equal gender relations<br>IV. Establish VSL groups to support alternative income-generating activities |
| We Effect (WE) consortium | Smallholder Improvement of Shire River Ecosystem ($515,197) | Upper Nasenga South (Mangochi) in 98 villages (two TAs) | ENRM | I. Train lead farmers in sustainable land use practices and dissemination of practices<br>II. Provide trainings for community members in SLM practices, including use of cover crops, mulch production, tree planting, vetiver grass planting, and use of drought-resistant crops<br>III. Conduct trainings in business management |
| | | | SGEF | I. Lobby village leaders and train community members to institute policies on gender equality<br>II. Establish VSL groups to support alternative income-generating activities |
| Women's Legal Resources Centre (WOLREC)[a] | Promoting the Socioeconomic Status of Women to Achieve Sustainable Environment and Natural Resource Management in Balaka and Neno Districts ($442,461) | Upper Rivirivi (Ntcheu); Nkasi (Balaka) in 81 villages (two TAs) | ENRM | I. Provide trainings in sustainable land use practices, including elephant grass planting, tree planting, and forest management |
| | | | SGEF | II. Establish community groups to discuss improved gender equality<br>III. Conduct trainings with women on leadership<br>IV. Conduct meetings/trainings to sensitize community members/leaders to gender equality<br>V. Establish adult literacy classes<br>VI. Establish VSL groups to support alternative income-generating activities |

Sources: Grant final reports, MCA grant closure forms, MCC 2018, and MCA-Malawi 2016.

[a]Grant focuses more extensively on SGEF activities than on ENRM activities. (Other grantees focus more extensively on ENRM activities.)

[b]Grantee began implementation in December 2015. (All other grantees began implementation in August 2015.)

[c]WE leads a consortium of implementing organizations for this grant that includes the Catholic Development Commission (CADECOM) and the Organisation for Sustainable Socio Economic Development Initiative (OSSEDI).

TA = Traditional Authority, an administrative unit.

**Table A.2. Grant facility proposal review score sheet**

| GUIDE FOR RATING<br>1. Unsatisfactory; 2. Marginal; 3. Satisfactory; 4. Very satisfactory<br>FOR A PROPOSAL TO BE ACCEPTED IT MUST SCORE AN AVERAGE OF AT LEAST 3 IN EACH SECTION | | |
|---|---|---|
| **Area for Evaluation** | **Criteria** | **SCORE** |
| **Organizational Capacity**: Does the Applicant demonstrate adequate financial and organizational capacity to implement the proposed Action? | 1. Sufficient relevant technical expertise and experience in applicant and partner organizations for proposed interventions | |
| | 2. Do the Applicant and partner/s have sufficient experience of project management to ensure that the proposed Action is successfully implemented? | |
| | 3. Do the Applicant and partners have sufficient management capacity--HRM, budget and equipment management for the proposed Action/s? | |
| | 4. Is the Applicant and partners able to contribute at least 10% of the project cost | |
| **AVERAGE SECTION RATING** | | |
| **Efficiency** | 5. Is the percentage of administration cost justifiable? Administration cost not to exceed 30% of the total project cost. | |
| | 6. Is the proposed budget coherent and balanced, and does it correspond to the funding needed for the activities' implementation? | |
| **AVERAGE SECTION RATING** | | |
| **Methodology**: Is there sufficient detail and coherence to the proposed Methodology? | 7. Does the implementation strategy reflect a logical process that would lead to achievement of the outputs/outcomes/objectives? | |
| | 8. Is the logical framework clearly presented and does it contain all required components (Objectives, Outputs/outcome, Activities, Objectively Verifiable Indicators and Source of Information)? | |
| | 9. Do the Applicant and partner organizations and staff have the capacity to participate fully in the monitoring of the intervention?<br>10. Is the Action plan clear and feasible with the proposed timeline? | |
| | 11. Are the proposed activities appropriate, practical and consistent with the objectives and expected results? | |
| | 12. Is the involvement and participation of local communities in the Action satisfactory? | |
| | 13. Does the project include innovative approaches that could be replicated characteristics in other context within the basin, or does it contribute to programmes having these? | |
| | 14. Does the project allow beneficiaries to innovate and try new technologies? | |
| | 15. Are the indicators Specific, Measurable, Achievable, Relevant and Time-bound (SMART)? | |
| **AVERAGE SECTION RATING** | | |
| **Sustainability** | 16. Are local communities actively involved in all stages of the proposed activities to ensure ownership (which is a pointer to sustainability)? | |
| | 17. Are plans in place for those activities that will continue after the end of this grant period? | |
| | 18. Is/are there structure/s that would make it possible to continue activities at the end of the project? | |
| | 19. Does the project promote environmental sustainability? | |

| GUIDE FOR RATING<br>1. Unsatisfactory; 2. Marginal; 3. Satisfactory; 4. Very satisfactory<br>FOR A PROPOSAL TO BE ACCEPTED IT MUST SCORE AN AVERAGE OF AT LEAST 3 IN EACH SECTION | | |
|---|---|---|
| **Area for Evaluation** | **Criteria** | **SCORE** |
| **Sustainability** | 20. Are local communities actively involved in the proposed actions to ensure ownership and sustainability? | |
| **AVERAGE SECTION RATING** | | |
| **Impact:**<br>Is it likely that the benefits will exceed the costs of the proposed Action and lead to impacts that achieve MCA-Malawi's broader objectives? | 21. Are the proposed activities likely to contribute towards reducing sediment load and water weed from hot spot areas in the upper and middle Shire River Basin which negatively affect HEPs downstream? | |
| | 22. Do the proposed actions demonstrate the potential for high poverty reduction impact (for ENRM Projects only)? Is the project likely to have broad impact on livelihoods of beneficiary communities? | |
| | 23. Is the proposed Action likely to promote sustainable food security and increase household incomes of participating communities? | |
| **AVERAGE SECTION RATING** | | |
| **Social and Gender Integration** | 24. Does the project adequately integrate social and gender concerns relating to participation of communities in ENRM activities? | |
| | 25. Does the project have a clear strategy for ensuring women and other vulnerable groups can fully participate and benefit from project activities? | |
| | 26. Are livelihoods and income generating aspects adequately covered in the project? | |
| | 27. Does the project consider power relations between men and women in terms of decision making and sharing of benefits from project activities? | |
| | 28. Are issues of business training and market access and pricing men and women adequately considered in the project? | |
| | 29. Are issues relating to leadership training for women adequately articulated? | |
| | 30. Does the proposal demonstrate an understanding of how local leaders will be involved and the type of gender training and advocacy required for local leadership support to ENRM interventions? | |
| | 31. Are issues pertaining to adult literacy and Savings and Loan training adequately articulated? | |
| **AVERAGE SECTION RATING** | | |
| **Capitalization of lessons learnt** | 32. Is the plan for dissemination of project results clearly articulated? | |
| | 33. Does the project contribute to dissemination of ideas, lessons learned and best practices? | |
| | 34. Is an activity planned to capitalize on lessons learned drawn from the project? | |
| **AVERAGE SECTION RATING** | | |
| **AVERAGE RATING FOR PROPOSAL** | | |

| Accepted | Accepted conditionally | Not accepted |
|---|---|---|
| | | |

**Summary of Reviewer Comments giving Reasons for Acceptance/ Conditional Acceptance/Rejection**

**Table A.3. Examples of ambiguous phrases from grant facility proposal score sheet**

| Criteria examples | Key phrases that require further definitions and examples |
|---|---|
| Sufficient relevant technical expertise and experience in applicant and partner organizations for proposed interventions | 'Sufficient relevant technical expertise and experience' |
| Do the Applicant and partner/s have sufficient experience of project management to ensure that the proposed Action is successfully implemented? | 'Sufficient experience of project management' |
| Do the Applicant and partners have sufficient management capacity--HRM, budget and equipment management for the proposed Action/s? | 'Sufficient management capacity' |
| Is the proposed budget coherent and balanced, and does it correspond to the funding needed for the activities' implementation? | 'coherent and balanced' |
| Do the Applicant and partner organizations and staff have the capacity to participate fully in the monitoring of the intervention? | 'capacity to participate fully' |
| Do the proposed actions demonstrate the potential for high poverty reduction impact (for ENRM Projects only)? Is the project likely to have broad impact on livelihoods of beneficiary communities? | 'demonstrate the potential' and 'likely to have broad impact' |
| Does the project adequately integrate social and gender concerns relating to participation of communities in ENRM activities? | 'adequately integrate' |
| Are issues of business training and market access and pricing men and women adequately considered in the project? | 'adequately considered' |

Source: Grant facility proposal review score sheet.

# Appendix B:

# Land Cover Change, SWAT MODEL, and Regional Climate Models

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# 1. Land cover change analysis

This section supplements Chapter VII with more detail on the land cover change (LCC) analysis.

The MODIS Land Cover Type Product provides land cover data for multiple classification systems. We selected the International Geosphere-Biosphere Programme (IGBP) scheme, from which we aggregated the 18 biome classes into nine. Table B.1 lists all biomes included in the IGBP classification system. Each entry is mapped into one of the nine aggregate biomes used in our analysis, shown in the last column.

**Table B.1. IGBP land cover classification system**

| No. | Biome name | Description | Aggregate biome |
|---|---|---|---|
| 1 | Evergreen needleleaf forests | Lands dominated by needleleaf woody vegetation with a percent cover >60 percent and height exceeding 2 m. Almost all trees remain green all year. Canopy is never without green foliage. | Forests |
| 2 | Evergreen broadleaf forests | Lands dominated by broadleaf woody vegetation with a percent cover >60 percent and height exceeding 2 m. Almost all trees and shrubs remain green year round. Canopy is never without green foliage. | Forests |
| 3 | Deciduous needleleaf forests | Lands dominated by woody vegetation with a percent cover >60 percent and height exceeding 2 m. Consists of seasonal needleleaf tree communities with an annual cycle of leaf-on and leaf-off periods. | Forests |
| 4 | Deciduous broadleaf forests | Lands dominated by woody vegetation with a percent cover >60 percent and height exceeding 2 m. Consists of broadleaf tree communities with an annual cycle of leaf-on and leaf-off periods. | Forests |
| 5 | Mixed forests | Lands dominated by trees with a percent cover >60% and height exceeding 2 m. Consists of tree communities with interspersed mixtures or mosaics of the other four forest types. None of the forest types exceeds 60 percent of landscape. | Forests |
| 6 | Closed shrublands | Lands with woody vegetation less than 2 m tall and with shrub canopy cover >60 percent. The shrub foliage can be either evergreen or deciduous. | Shrublands |
| 7 | Open shrublands | Lands with woody vegetation less than 2 m tall and with shrub canopy cover between 10 percent and 60 percent. The shrub foliage can be either evergreen or deciduous. | Shrublands |
| 8 | Woody savannas | Lands with herbaceous and other understory systems, and with forest canopy cover between 30 percent and 60 percent. The forest cover height exceeds 2 m. | Shrublands |
| 9 | Savannas | Lands with herbaceous and other understory systems, and with forest canopy cover between 10 percent and 30 percent. The forest cover height exceeds 2 m. | Shrublands |
| 10 | Grasslands | Lands with herbaceous types of cover. Tree and shrub cover is less than 10 percent. | Grasslands |
| 11 | Permanent wetlands | Lands with a permanent mixture of water and herbaceous or woody vegetation. The vegetation can be present either in salt, brackish, or fresh water. | Wetlands |

| No. | Biome name | Description | Aggregate biome |
|---|---|---|---|
| 12 | Croplands | Lands covered with temporary crops followed by harvest and a bare soil period (e.g., single and multiple cropping systems). Note that perennial woody crops will be classified as the appropriate forest or shrub land cover type. | Croplands |
| 13 | Urban and built-up lands | Land covered by buildings and other man-made structures. | Urban |
| 14 | Cropland/natural vegetation mosaics | Lands with a mosaic of croplands, forests, shrubland, and grasslands in which no one component comprises more than 60 percent of the landscape. | Croplands |
| 15 | Snow and ice | Lands under snow/ice cover throughout the year. | Snow |
| 16 | Barren | Lands with exposed soil, sand, rocks, or snow and never have more than 10 percent vegetated cover during any time of the year. | Bare |
| 17 | Water bodies | Oceans, seas, lakes, reservoirs, and rivers. Can be either fresh or salt-water bodies. | Water |

Note: Table reports the land cover classes of the International Geosphere-Biosphere Programme (IGBP). Class 18, not shown, denotes 'no values.' Biomes listed in the "Aggregate class" column correspond to the final land cover class used in our analysis.

# 2. SWAT model analysis

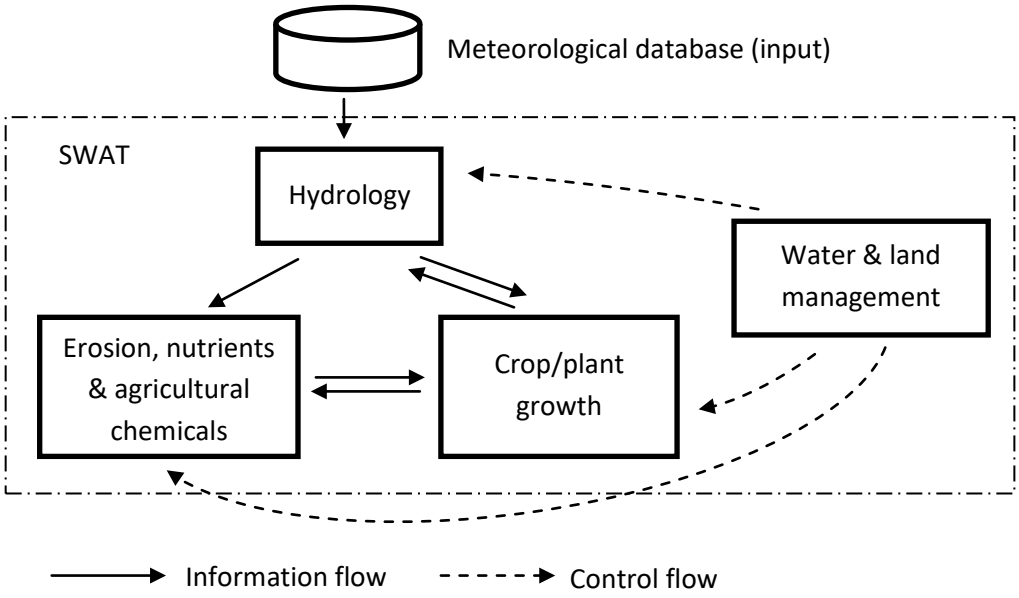
This section of the appendix supplements Chapters III and VII with additional detail on the SWAT model, its setup, the required input datasets, and the development of the policy scenario.

## A. SWAT model setup

Figure B.1 describes the structure of the Soil and Water Assessment Tool (SWAT) model, created using ArcSWAT, including both information flows from the meteorological database to the hydrology and from the hydrology to levels of erosion and crop growth and related interactions.[32] The figure also describes a series of control flows that influence these interactions, such as changes in land and water management. Changes in land management could relate to reforestation or the use of soil control structures, such as soil bunds or agricultural management practices, such as conservation agriculture. Changes in water management include the use of irrigation methods, or changes in various types of water structures. These changes can affect hydrology, soil erosion, and crop growth.

[32] Neitsch et al. (2011) provides a complete description of the SWAT model simulation methodology.

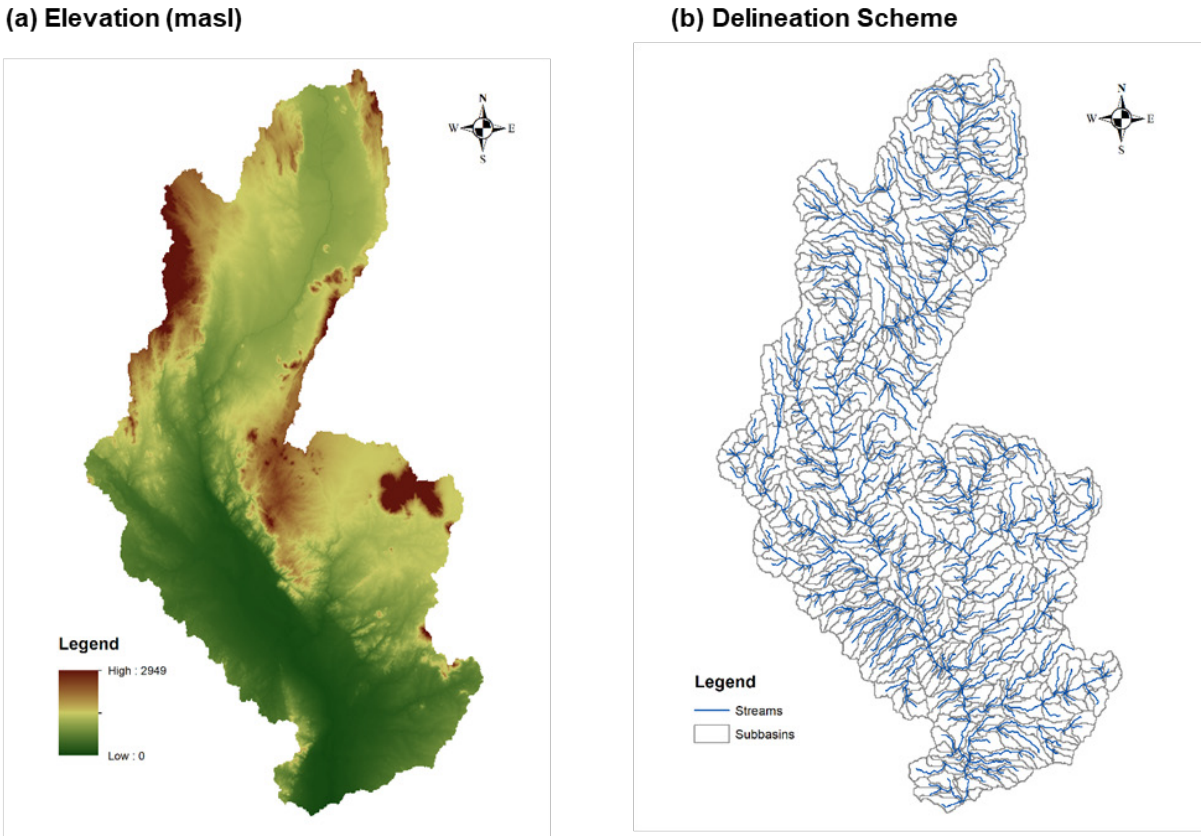
**Figure B.1. Structure of the Soil and Water Assessment Tool (SWAT)**




Note: Based on Neitsch et al. (2011).

The first step in the SWAT model setup consists of the delineation of watersheds. For this, the study watershed is partitioned into sub-basins through a topographic analysis using digital elevation model (DEM) data to provide a discretized representation of the study river basin for modeling. The sub-basins are defined so that precipitation that falls into a sub-basin drains into the outlet of that sub-basin. The hydrologically conditioned 90-meter DEM data (Figure B.2a) used for the water delineation in this study were obtained from the HydroSHEDS database (Lehner et al. 2008). The delineation scheme developed is shown in Figure B.2b. The study area in the Shire River Basin is divided into 770 sub-basins. One stream segment is associated with each sub-basin. These stream segments are defined to represent the drainage network within the study river basin, although a stream segment does not necessarily correspond to an observed, perennial river channel.

**Figure B.2. Shire River Basin elevation and delineation scheme used in the SWAT modeling**




Note: Both elevation values (meters above sea level) and the delineation scheme are derived from the HydroSHEDS DEM (Lehner et al., 2008).

The second step in model set up is the definition of hydrologic response units (HRUs). SWAT allows the definition of multiple HRUs within a sub-basin. The definition of HRUs helps improve the model's capacity to reflect the heterogeneity of land use, soils, and land management practices. HRUs act as spatial units for the calculation of water and sediment yield in SWAT, that is, for every day of the simulation period, sediment and other water quality constituents are calculated for each HRU and then aggregated to the sub-basin level and routed through the stream network. In the setup of the Shire-SWAT model, we defined HRUs to represent the distribution of land use and land cover in the 770 sub-basins. Thus, a sub-basin may have several HRUs if there is heterogeneity in land use, such as forest, shrubland, grassland and cropland. Cropland HRUs in a sub-basin are further split into those with land soil erosion control and those without. The number and size of HRUs varies in the scenario analysis according to the specified land cover scenarios. The baseline scenario includes 2,680 HRUs, the BAU scenario 2,936 HRUs, and the "policy" scenario 2,503 HRUs.

## B. Input data details

The SWAT Shire, Malawi model was created using the SWAT GIS interface software, whose default soil database was replaced with a user soil property database for the Shire River Basin.

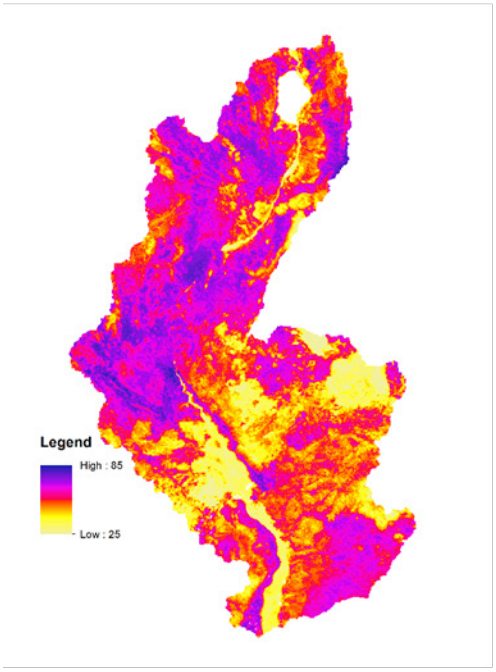
Chapter III Section B.2 of this report offers an overview of the key data sources inputted into the SWAT model.

The soil properties available from the International Soil Reference and Information Centre (ISRIC) soil database include soil texture: fractions of sand, clay and silt and content of organic carbon (Figures B.3 a-d). Other soil properties required for SWAT modeling, such as saturated hydraulic conductivity, soil available water capacity, and soil erodibility factors were estimated using soil texture and content of soil organic carbon from the ISRIC database (Stewart et al. 1975, Reynolds et al. 2000, Schaap et al. 2001). A precipitation time-series for each sub-basin was extracted for the centroid of each sub-basin polygon.

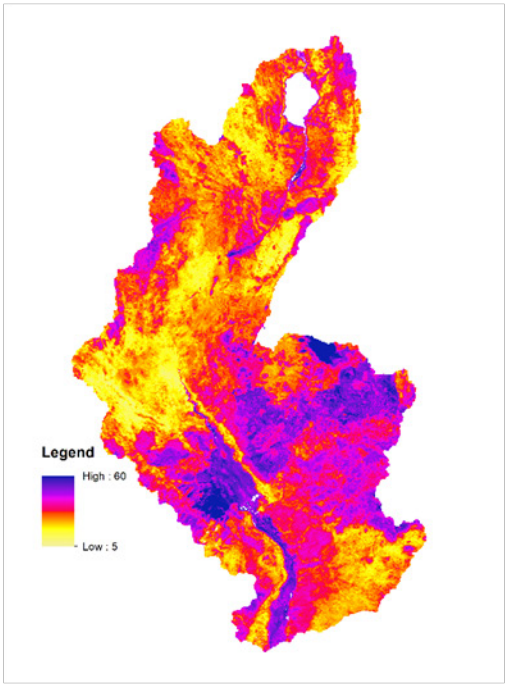
Finally, as an outlet of Lake Malawi, the Shire River receives water and sediment loadings from the lake. The flow regime of the Shire River is heavily influenced by the lake water level. Due to the complexity of hydrological and sedimentation processes in the lake region and the scarcity of data required to simulate these processes, water and sediment budgets of Lake Malawi were not modeled in the study. Sediment outflow from Lake Malawi to the Shire River was omitted, and discharge data from the hydropower station at Mangochi (Børge Storm, personal communication, 2017), where outflows from Lake Malawi to the Shire River are measured, were used as water inflows to inform the hydrological simulation in the SWAT-Shire model including under scenarios with climate change.

**Figure B.3. Shire River Basin top layer soil texture and organic carbon content**

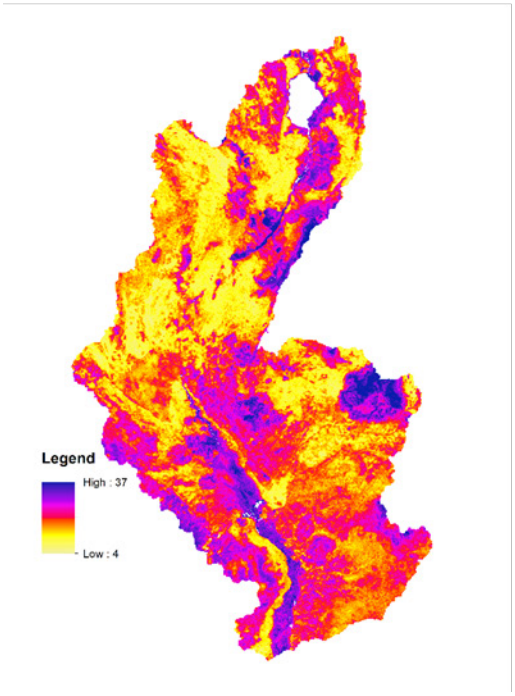
(a) Sand (%)



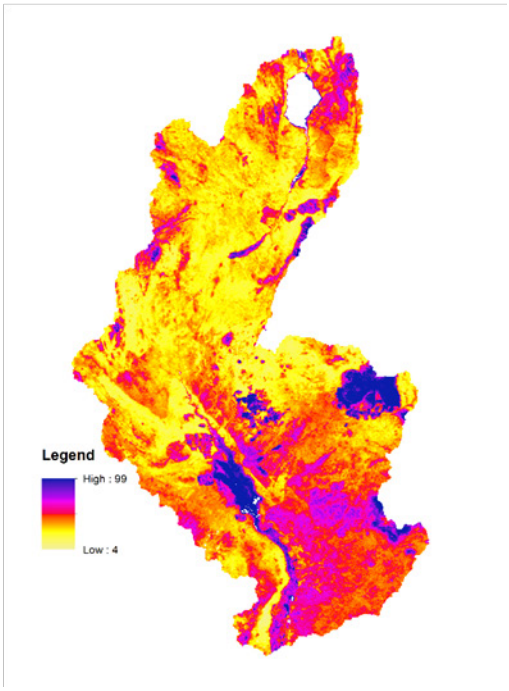

(b) Clay (%)




(c) Silt (%)




(d) Organic carbon (%)



## C. Parameterizing the SWAT soil erosion simulation

A core module in SWAT for simulating sedimentation processes is the modified universal soil loss equation (MUSLE) (Williams, 1975). The MUSLE operates on a daily basis and links soil erosion rates from land with various land cover/land use types with the runoff estimated by the hydrological simulation module of SWAT:

$$sed = 11.8 \cdot (Q_{surf} \cdot q_{peak} \cdot area_{hru})^{0.56} \cdot K_{USLE} \cdot C_{USLE} \cdot P_{USLE} \cdot LS_{USLE} \cdot CFGR$$

where *sed* is the sediment yield on a given day (tons), $Q_{surf}$ is the surface runoff volume (mm $H_2O$/ha), $q_{peak}$ is the peak runoff rate $\left(m^3 / s\right)$, $area_{hru}$ is the area of the HRU in hectares (ha), $K_{USLE}$ is the soil erodibility factor $\left(0.013\left(\text{metric ton m}^2 \text{ hour}\right)/\left(\text{m}^3 - \text{metric ton cm}\right)\right)$, $C_{USLE}$ is the cover and management factor, $P_{USLE}$ is the support practice factor, $LS_{USLE}$ is the topographic factor, and $CFGR$ is the coarse fragment factor.

In the SWAT simulation, the MUSLE is applied at the HRU level, and parameters of the equation may vary across HRUs.

The topographic factor $LS_{USLE}$ and coarse fragment factor $CFGR$ are estimated in the model according to input data on slopes and the first soil layer's rock share (Neitsch et al., 2011).

$$LS_{USLE} = \left(\frac{L_{hill}}{22.1}\right)^{m} \left(65.41 sin^2\left(\alpha_{hill}\right) + 4.56 sin\ \alpha_{hill} + 0.065\right)$$

where $L_{hill}$ is the slope length (m), $m$ is an exponential term, and $\alpha_{hill}$ is the angle of the slope. The exponential term $m$ is calculated as

$$m = 0.6\left(1 - exp\left[-35.835\right] slp\right)$$

is the slope of the HRU expressed as rise over run (m/m).

$$CFGR = exp\left(-0.053\ rock\right)$$

where $rock$ is the rock share in the first soil layer (%) and is equal to 0 in soils (thus *CFRG = 1*) in all sub-basins in the Shire River Basin.

The soil erodibility factor $K_{USLE}$ is a parameter included in the ArcSWAT soil database and the estimation of $K_{USLE}$ is part of the ArcSWAT soil database building activity. $K_{USLE}$ is calculated as a function of content of sand, silt, clay, and organic carbon (Sharply and Williams, 1990).

$$K_{USLE} = \left(0.2 + 0.3\ exp\left[-0.0256 SAN\left(1 - SIL/100\right)\right]\right)\left(\frac{SLT}{CLA + SLT}\right)^{0.3}$$
$$\left(1 - \frac{0.25 OC}{OC + exp\left[3.72 - 2.95 OC\right]}\right)\left(1 - \frac{0.75 SN}{SN + exp\left[22.9 SN - 5.51\right]}\right)$$

where *SAN* is the sand content (%), *SIL* is the silt content (%), *CLA* is the clay content (%), *OC* is the soil organic carbon content (%), and *SN=1-SAN/100*.

The values of surface runoff volume $Q_{surf}$ and runoff peak rate $q_{peak}$ in the MUSLE are estimated by the hydrological simulation module using the Soil Conservation Service (SCS) curve number method (USDA Soil Conservation Service, 1972), in which runoff potential from rainfall excess of a HRU is characterized by a parameter called the moisture condition II curve number (CN2). The CN2 value varies with land cover and soil type; a higher value of CN2 indicates larger potential for runoff generation.

Similarly, the value of the universal soil loss equation (USLE) cover and management factor, $C_{USLE}$, changes with land cover type. In the SWAT model setup, the values of the CN2 and $C_{USLE}$ were firstly populated by ArcSWAT according to lookup tables embedded in the software. Considering the large uncertainty in the initial estimates of the two parameters and the sensitivity of the SWAT sediment simulation output to the two parameters, CN2 and $C_{USLE}$, together with another sensitive parameter, soil evaporation compensation coefficient (ESCO), were selected as adjustable parameters in the ensuing calibration procedure. Calibration is recommended in SWAT modeling to improve model performance (Neitsch et al., 2011). While there is a lack of monitoring data on suspended sediment in the channels of the Shire River, ballpark estimates for the sediment inflow rates of the three reservoirs (Nkula, Tedzani, and Kapichira) were available (FICHTNER, 2014) and used in the calibration of the SWAT-Shire model. The calibrated values of these parameters are shown in Table B.2.

**Table B.2. SWAT model calibration parameters and calibrated values**

| Parameter | Spatial level | Initial value | Calibrated value |
|---|---|---|---|
| CN2 | HRU | 55-92 | Reduced by 20% |
| $C_{USLE}$ (forest) | HRU | 0.001 | 0.0005 |
| $C_{USLE}$ (shrubland) | HRU | 0.003 | 0.015 |
| $C_{USLE}$ (grassland) | HRU | 0.003 | 0.03 |
| $C_{USLE}$ (cropland) | HRU | 0.2 | 0.05 |
| ESCO | Shire River Basin | 0.95 | 0.05 |

CN2 = initial SCS runoff curve number for moisture condition II; $C_{USLE}$ = USLE daily cover management factor; HRU = hydrological response unit; ESCO = soil evaporation compensation coefficient.

The support practice factor, $P_{USLE}$, is defined as the ratio of soil loss with a specific support practice to the corresponding loss with up-and-down slope cultivation. Soil erosion control measures vary by cropland HRU in the SWAT-Shire model, and $P_{USLE} = 1$ in HRUs without control measures. Following recommendations from the conservation practices modeling guide for SWAT (Waidler et al., 2011), reduced values of $P_{USLE}$, CN2, and average slope length are

used for the sediment yield estimation to characterize the impact of soil erosion control (Table B.3).

**Table B.3. Parameter values for modeling the impact of land soil erosion control measures**

| Parameter | Original value (for cropland without soil erosion control) | Modified value (for cropland with soil erosion control) |
|---|---|---|
| $P_{USLE}$ | 1.0 | 0.5 |
| CN2 | Calibrated values in Table A.2 | Reduced calibrated values by 5 |
| Average slope length (m) | 61 | 10 |

Note: $P_{USLE}$ = support practice factor; CN2 = Initial SCS runoff curve number for moisture condition II.

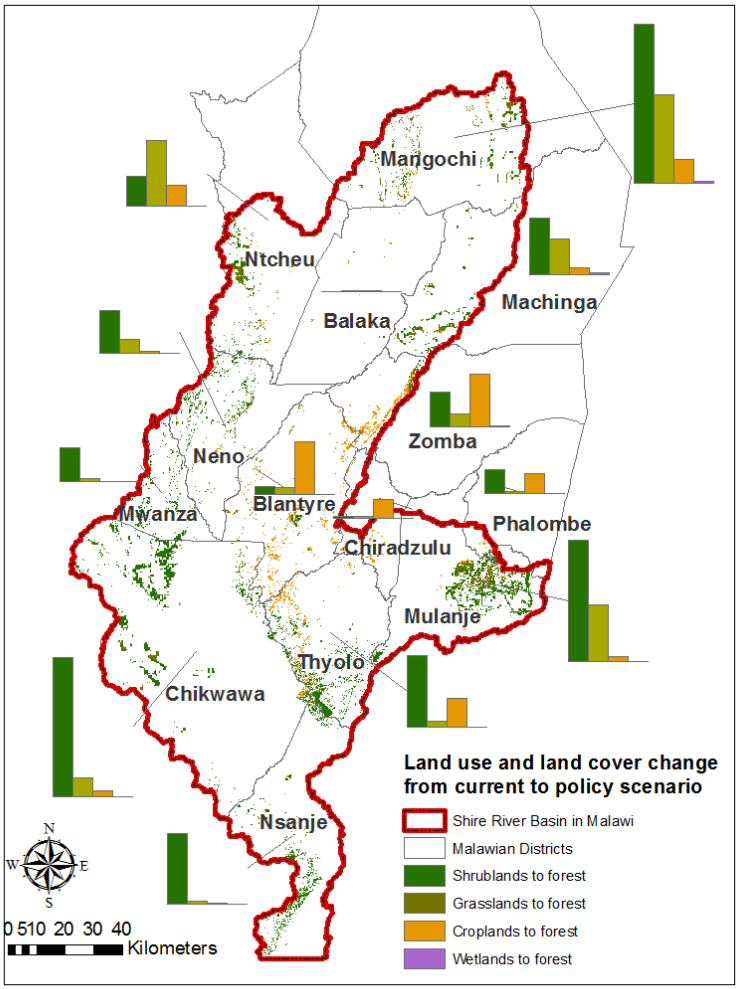
## D. Scenario development

### 1. Reforestation and restoration of areas with high erosion hazards

The Government of Malawi identified 7.7 million hectares of opportunity land for restoration, among which 4.5 million hectares are prioritized in accordance with the country's commitment to the AFR100 initiative. They report that "initial estimates of landscapes targeted for restoration amount to 1.5 million hectares for improved forest management and 3 million hectares for increased tree cover and soil and water conservation on agricultural land, including river and stream-bank restoration" (MNREM 2017a).

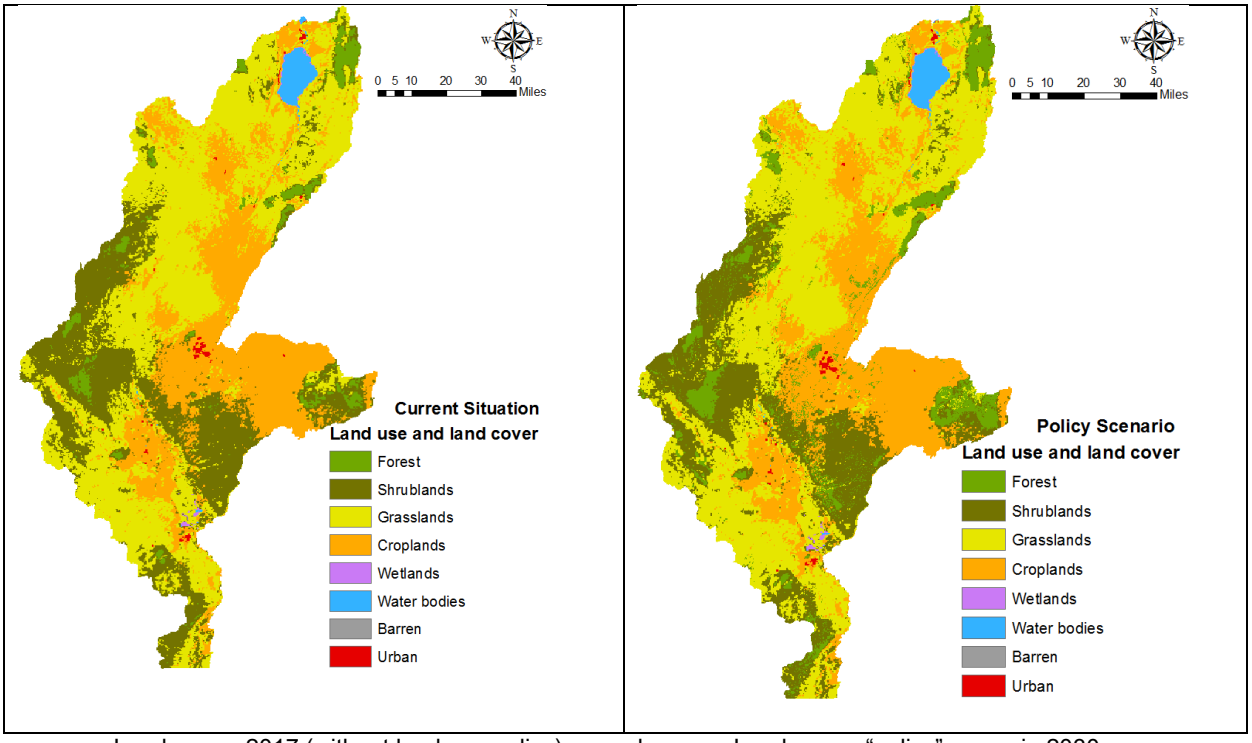
Adapting these objectives into our policy scenario, we project that all existing agricultural land (2.7 million hectares, as calculated using the most recent year of data for the MODIS Land Cover Type Product) will be restored through better management, such as the adoption of conservation agriculture and agroforestry practices. Our scenario also includes 1 million hectares of improved forest management practices applied to existing forest and dense shrublands. River- and stream-banks, areas with steep slopes, and degraded forests are all priority areas for afforestation activities given the significant contribution that restoration can make towards sedimentation reduction in such areas. Figure B.4 illustrates the afforestation activities, by district, that the policy scenario encompasses. Figure B.5a depicts the current land cover composition of the Shire River Basin, using the MODIS Land Cover Type Product (Friedl et al. 2019), while Figure B.5b presents the basin's land cover for the policy scenario.

**Figure B.4. Shire River Basin reforestation by district under policy scenario**




Source: Authors' calculations using Friedl and Sulla-Menshe (2019). Restoration of biomes to reach GoM goals was determined based on MNREM information on high priority areas for land restoration.

**Figure B.5. Shire River Basin land cover before and after implementation of policy objectives**




a. Land cover, 2017 (without land use policy) b. Land cover, "policy" scenario 2030

Source: Authors' calculations using Friedl and Sulla-Menshe (2019). Restoration of biomes to reach GoM goals was determined based on MNREM information on high priority areas for land restoration.

## 2. Soil erosion control on cropland

As there is currently no Shire River Basin inventory of land management practices on cropland, we focus on soil erosion control practices for which we have access to data from household surveys, and specifically from the 2017 World Bank LSMS. Adoption rates of soil erosion control practices per district are summarized in Table B.4. Households deploying at least one soil erosion control practice are considered adopters for our assessment and district level rates are calculated from household level data, as these are representative samples at district level. For modeling purposes, we assume that these practices are fully effective in controlling erosion. While this is a strong assumption, effective implementation of soil erosion control is one essential component to meet the Government of Malawi's commitment to land restoration. Specifically, we assign the district level rates of adoption of these practices to the sub-basins where these districts are located.

Within the sub-basins, we assume that farmers prioritized use of soil and water conservation structures based on given erosion risks, that is, areas with the highest erosion risks received soil and water conservation structures before other areas. This reflects the LSMS survey module asking only if soil erosion control measures had been adopted if soil erosion problems were perceived.

**Table B.4. Adoption rate of soil erosion control measures in Shire River Basin by district**

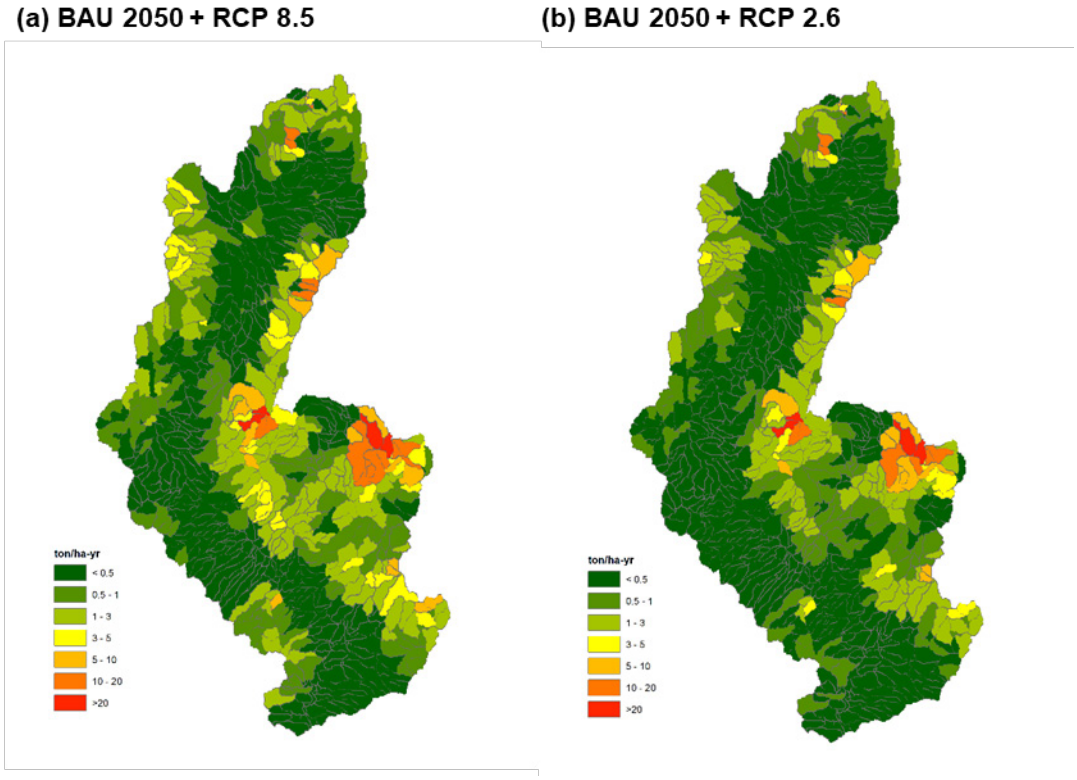
| District | Soil erosion control adoption rate (%) |
|---|---|
| Balaka | 38 |
| Blantyre | 36 |
| Chikwawa | 36 |
| Chiradzulu | 46 |
| Machinga | 53 |
| Mangochi | 20 |
| Mulanje | 24 |
| Mwanza | 47 |
| Neno | 52 |
| Nsanje | 48 |
| Ntcheu | 19 |
| Phalombe | 20 |
| Thyolo | 53 |
| Zomba | 57 |
| Average | 39 |
| *Average for Rest of Malawi* | *42* |

Note: All values are calculated from weighted, household survey responses to the World Bank's 2017 Living Standard Measurement Survey (LSMS).

## E. Results

In the SWAT analysis, we estimate sediment yields by sub-basin for each of the modeled scenarios. Figure B.6 complements Figure VII.3 and depicts yields under the two BAU 2050 scenarios with severe and modest climate change. The spatial pattern and magnitude of reduction estimates are similar to those of the BAU 2030 scenario.

**Figure B.6. Sediment yields under the BAU 2050 scenarios**




Note: All calculations are performed at the sub-basin level using the SWAT Shire, Malawi model. Representative concentration pathway 8.5 (RCP 8.5) and RCP 2.6 respectively correspond to the "severe climate change" and "modest climate change" scenarios.

## 3. Regional climate model selection

Precipitation is a crucial input into all hydrological models. Our SWAT model analysis thus far has relied on historical rainfall data, whereas predictions of future erosion patterns and sedimentation rates require rainfall projections. This is especially important when forecasts vary greatly from historical values, the magnitude of which can only be ascertained empirically. Since climate change is likely to have significant effects on hydrological systems throughout Africa (De Wit and Stankiewicz 2006, Nikulin et al. 2012, Niang et al. 2018), long-run forecasts of the impact of land conservation on hydropower productivity in the Shire River Basin should incorporate the most probable precipitation scenarios generated from climate model predictions.

We analyzed projections from the 35 regional climate models (RCMs) shown in Table B.5, and selected two to assess the effects of future precipitation patterns. Climatologists develop general circulation models (GCMs) to model the evolution of climatic variables for the entire globe, and RCMs are downscaled versions of these GCMs often with a continental focus. We draw on models developed specifically for all of Africa. RCMs possess finer spatial resolution than GCMs and may be able to resolve smaller-scale climatic features that coarse GCM models are

unable to, potentially leading to predictions that are more accurate than those from GCM output.[33]

**Table B.5. List of evaluated regional climate models**

| Driving model | Institute | RCM model | Experiment | Ensemble |
|---|---|---|---|---|
| 1. CCCma-CanESM2 | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 2. CNRM-CERFACS-CNRM-CM5 | CLMcom | CCLM4-8-17 | RCP 8.5 | r1i1p1 |
| 3. CNRM-CERFACS-CNRM-CM5 | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 4. CSIRO-QCCCE-CSIRO-Mk3-6-0 | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 5. ICHEC-EC-EARTH | CLMcom | CCLM4-8-17 | RCP 8.5 | r12i1p1 |
| 6. ICHEC-EC-EARTH | DMI | HIRHAM5 | RCP 8.5 | r3i1p1 |
| 7. ICHEC-EC-EARTH | KNMI | RACMO22T | RCP 2.6 | r12i1p1 |
| 8. ICHEC-EC-EARTH | KNMI | RACMO22T | RCP 8.5 | r1i1p1 |
| 9. ICHEC-EC-EARTH | MPI-CSC | CSC | RCP 2.6 | r12i1p1 |
| 10. ICHEC-EC-EARTH | MPI-CSC | CSC | RCP 8.5 | r12i1p1 |
| 11. ICHEC-EC-EARTH | SMHI | RCA4 | RCP 2.6 | r12i1p1 |
| 12. ICHEC-EC-EARTH | SMHI | RCA4 | RCP 8.5 | r12i1p1 |
| 13. IPSL-IPSL-CM5A-LR | GERICS | REMO2009 | RCP 2.6 | r1i1p1 |
| 14. IPSL-IPSL-CM5A-LR | GERICS | REMO2009 | RCP 8.5 | r1i1p1 |
| 15. IPSL-IPSL-CM5A-MR | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 16. MIROC-MIROC5 | GERICS | REMO2009 | RCP 2.6 | r1i1p1 |
| 17. MIROC-MIROC5 | GERICS | REMO2009 | RCP 8.5 | r1i1p1 |
| 18. MIROC-MIROC5 | SMHI | RCA4 | RCP 2.6 | r1i1p1 |
| 19. MIROC-MIROC5 | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 20. MOHC-HadGEM2-ES | CLMcom | CCLM4-8-17 | RCP 8.5 | r1i1p1 |
| 21. MOHC-HadGEM2-ES | GERICS | REMO2009 | RCP 2.6 | r1i1p1 |
| 22. MOHC-HadGEM2-ES | GERICS | REMO2009 | RCP 8.5 | r1i1p1 |
| 23. MOHC-HadGEM2-ES | KNMI | RACMO22T | RCP 2.6 | r1i1p1 |
| 24. MOHC-HadGEM2-ES | KNMI | RACMO22T | RCP 8.5 | r1i1p1 |
| 25. MOHC-HadGEM2-ES | SMHI | RCA4 | RCP 2.6 | r1i1p1 |
| 26. MOHC-HadGEM2-ES | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 27. MPI-M-MPI-ESM-LR | CLMcom | CCLM4-8-17 | RCP 8.5 | r1i1p1 |
| 28. MPI-M-MPI-ESM-LR | MPI-CSC | CSC | RCP 2.6 | r1i1p1 |
| 29. MPI-M-MPI-ESM-LR | MPI-CSC | CSC | RCP 8.5 | r1i1p1 |
| 30. MPI-M-MPI-ESM-LR | SMHI | RCA4 | RCP 2.6 | r1i1p1 |
| 31. MPI-M-MPI-ESM-LR | SMHI | RCA4 | RCP 8.5 | r1i1p1 |

[33] We considered all RCMs encompassing Africa that were developed for the Coordinated Regional Climate Downscaling Experiment (CORDEX), and are accessible through the Earth System Grid Federation (ESGF) nodes. All models use a 0.44° grid and are listed in Table B.5.

| Driving model | Institute | RCM model | Experiment | Ensemble |
|---|---|---|---|---|
| 32. NCC-NorESM1-M | SMHI | RCA4 | RCP 2.6 | r1i1p1 |
| 33. NCC-NorESM1-M | SMHI | RCA4 | RCP 8.5 | r1i1p1 |
| 34. NOAA-GFDL-GFDL-ESM2G | GERICS | REMO2009 | RCP 2.6 | r1i1p1 |
| 35. NOAA-GFDL-GFDL-ESM2M | SMHI | RCA4 | RCP 8.5 | r1i1p1 |

CLMcom = Climate Limited-area Modelling Community (CLM-Community); DMI = Danish Meteorological Institute; GERICS = Helmholtz-Zentrum Geesthacht, Climate Service Center Germany; KNMI = Royal Netherlands Meteorological Institute, De Bilt, The Netherlands; MPI-CSC = Helmholtz-Zentrum Geesthacht, Climate Service Center, Max Planck Institute for Meteorology; SMHI = Swedish Meteorological and Hydrological Institute, Rossby Centre; RCP = Representative Concentration Pathway. The two highlighted models are those used in our analysis.

The two chosen scenarios resulted from a two-step selection process. For shorthand, we will refer to them as the (1) "modest climate change model" and the (2) "severe climate change model." They are, respectively, the ICHEC EC EARTH KNMI-RACMO22T r12i1p1 and the ICHEC EC EARTH KNMI-RACMO22T r1i1p1 models, and those names are shorthand for the institutions developing the models, the driving GCM they are based on, their downscaling method, and assumptions embedded in the model about climate physics, initial states, and how the models are initialized.

We do not know with certainty what future temperature and precipitation levels will be, because we do not know for certain the cumulative volume of greenhouse gases (GHG) that will be emitted into the earth's climate system. The state of the future climate will depend both on factors that humans have control over (for example, the energy-intensity of the global economy, population levels, and the predominant energy sources) and the responsiveness of the earth's climate system to GHG concentrations, also known as climate sensitivity. To examine potential ways in which the global economy will develop requires the use of scenarios. All RCM model projections adopt Representative Concentration Pathways (RCPs), which are standardized trajectories of how global greenhouse gas emissions levels will evolve into the future.[34] The RCPs correspond to the extent to which GHG abatement efforts have been performed, and represent scenarios of how the global economy develops through 2100 (van Vuuren et al. 2011).

The total cumulative emissions of GHGs is one of the most important margins contributing to differences in forecast values among different RCMs, and so our **first step** in the model selection process was to pick one model each from two key RCPs. The RCP 2.6 trajectory reflects comparatively low GHG concentration increases above current levels, while the RCP 8.5 scenario represents a high GHG concentration growth scenario. The difference between the two is largely driven by different assumptions about the scale of investments in renewable energy and energy efficiency, and the growth of global fossil fuel combustion. The numbers in the RCPs denote the radiative forcing values in 2100, which is the imbalance between incoming energy from the sun and the amount of energy the planet radiates into space. For example, the RCP 2.6 trajectory simulates 2.6 $W/m^2$ of forcing at the end of the century. Higher values are associated with more warming, and the magnitude of radiative forcing is one of the most important factors

[34] GHGs are well mixed in the atmosphere such that their effect on trapping heat is independent of their geographic source.

influencing global temperature, and consequently precipitation patterns. Of the 35 simulations, 22 use RCP 8.5 and the remaining 13 adopt RCP 2.6; not all models are run using both RCPs. Consequently, our chosen RCP 2.6 model is the "modest climate change model," and the RCP 8.5 model the "severe" one.

In our **second step**, models with more accurate hindcasts, or "predictions" of past rainfall, are strictly preferred. Each RCM produces a "historical" simulation, which we compare against Climate Hazards Group InfraRed Precipitation with Station data (CHIRPS), a blended satellite-station rainfall estimation data product produced by Funk et al. (2015) at UC Santa Barbara with daily data available for 1981 to present. The temporal overlap for the CHIRPS precipitation data and the RCMs' historical runs is 1981–2005, which is the time period over which we conduct ordinary least squares regression models to evaluate RCM performance. All data sources are spatially averaged over the Shire River Basin, which generates a daily time-series. For each RCM, we regress CHIRPS rainfall data on the RCM's model output, and interpret the resulting $R^2$ from the regression as a proxy for RCM performance. The preferred model is the one that produces the highest $R^2$ value, signifying that that RCM explains more of the variance in the CHIRPS data than any alternative.

For each RCM, we ran two model performance tests of how well the rainfall record could be reproduced, using regressions with (a) daily rainfall, and (b) monthly total rainfall. Figure B.7 plots the $R^2$ for the (a) models on the x-axis, and the (b) models on the y-axis. The positive trend indicates that models with relatively high predictive accuracy at daily resolution tend to also exhibit high monthly resolution accuracy. Our two chosen models, both drawing on the ICHEC EC-Earth KNMI-RACMO22T model, are the top performers according to these metrics and appear in the upper right corner of the plot with the highest $R^2$ values from both daily-frequency regressions and monthly-frequency regressions. These two models also have the benefit of representing both RCPs; the "modest climate change model" (in red) adopts the RCP 2.6 trajectory, and the "severe climate change model" (in green) uses RCP 8.5.

**Figure B.7. RCM performance from CHIRPS regressions**

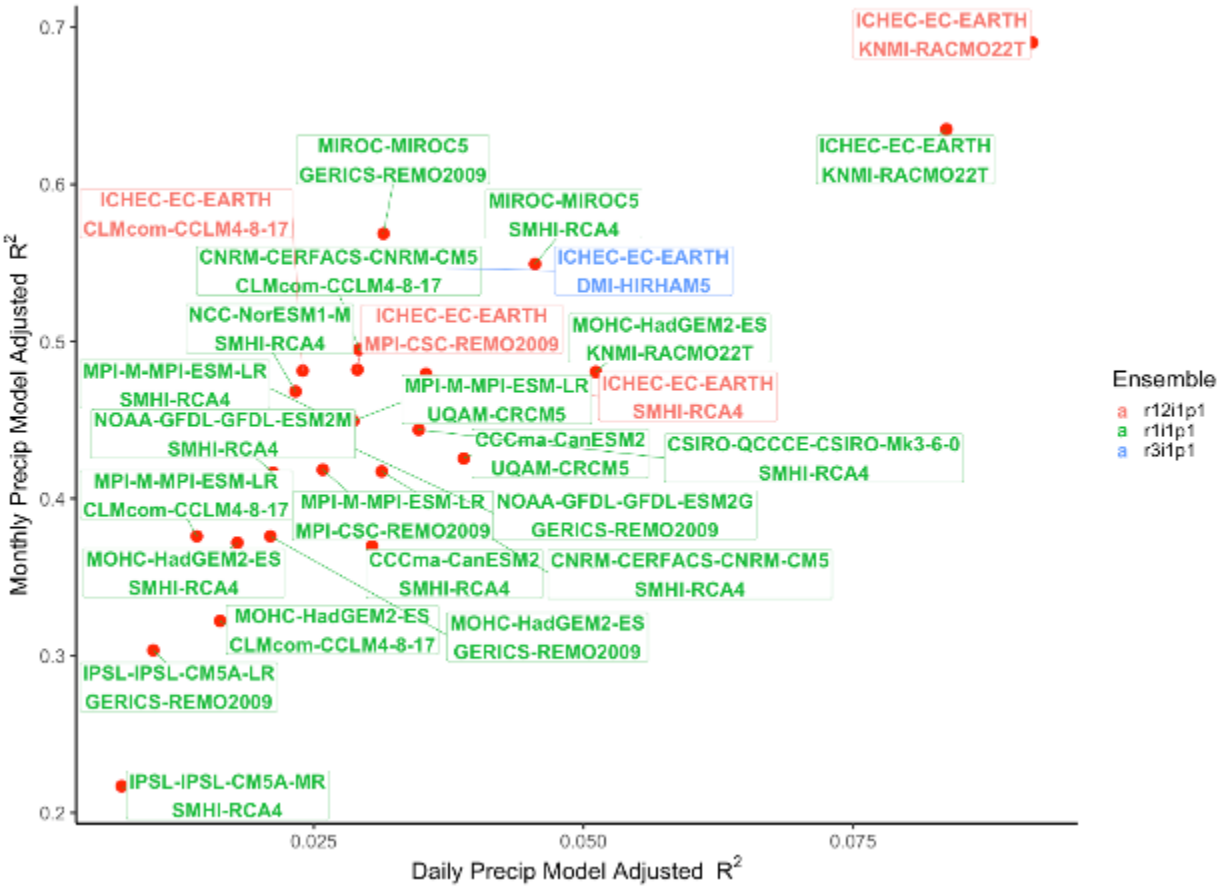



Figure B.8 plots kernel density estimates of annual average precipitation over the Shire River Basin for the CHIRPS data (solid gray), along with the two models' historical (solid) and forecast (dashed) runs. Over the historical period (1981–2005), the RCP 2.6 model predicted more rainfall than under the RCP 8.5. Both models predicted a narrower range of values than the CHIRPS estimates, whose individual realizations are represented as vertical lines on the x-axis rug plot. For both RCMs, forecasts are decidedly drier with the entire distributions shifted left-ward from their historical values. The RCP 8.5 forecast includes a long right-tail, whereas the RCP 2.6 output suggests no years with rainfall exceeding 1,200 mm between 2040 and 2060.

**Figure B.8. Kernel density estimates of Shire River Basin annual precipitation for the selected RCMs and CHIRPS**

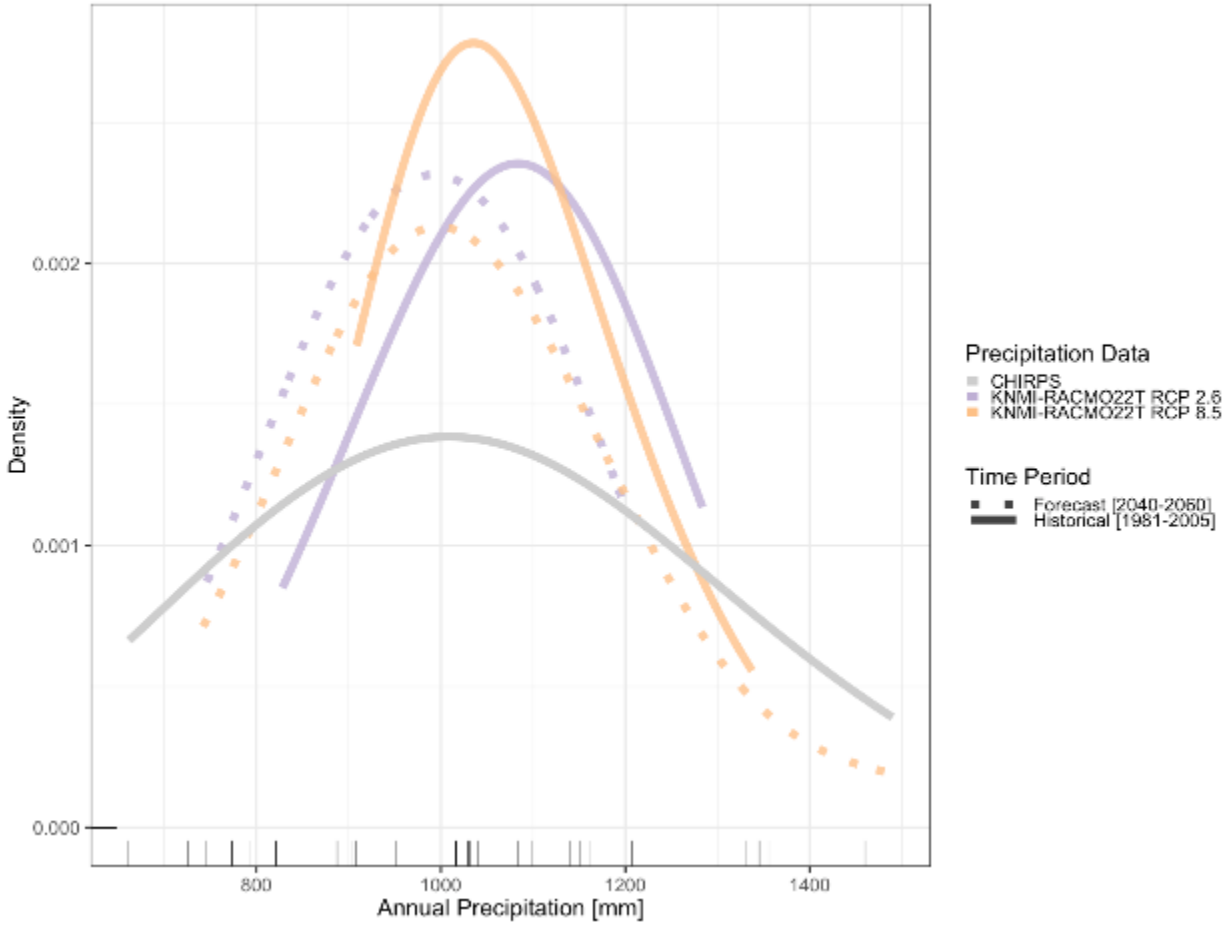
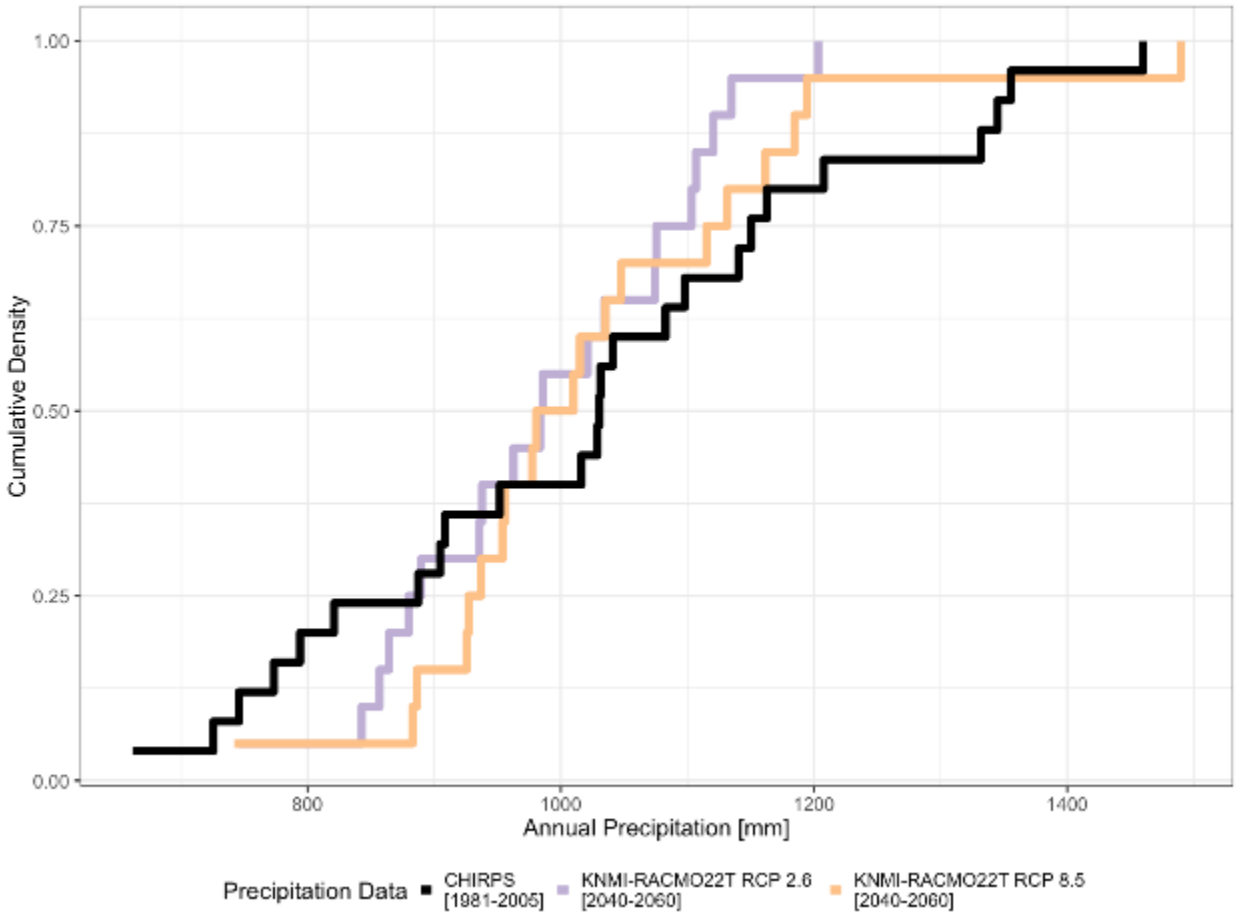



Figure B.9 presents an alternative way of viewing the contrast between RCM forecasts and the CHIRPS historical record. The figure features cumulative density plots that illustrate precipitation levels as percentiles over the indicated time periods. Again we observe that CHIRPS' estimated rainfall realizations are more dispersed and overall wetter than forecasts. Whereas more than 55 percent of the years between 1981 and 2005 received at least 1,000 mm of rainfall, respectively 50 percent (RCP 8.5) and 45 percent (RCP 2.6) of years in the 2040–2060 period are projected to exceed 1,000 mm in the forecast runs.

In summary, we have selected two models, a “modest climate change scenario” and a “severe climate change scenario,” that represent two divergent paths along which the global economy might develop. These two models should capture much of the uncertainty of future precipitation levels in the Shire River Basin, because future GHG levels, proxied by the level of climate change severity in our selected models, are one of the most important factors driving future precipitation. Lastly, among the pool of all RCMs using either RCP 2.6 or RCP 8.5, we selected models that best explained the variation in historical rainfall patterns for the Shire River Basin.

**Figure B.9. Cumulative density plots of Shire River Basin annual precipitation for selected RCMs and CHIRPS**



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# Appendix C:

# Stakeholder Comments and Evaluator Responses

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**Table C.1. Evaluator Comments**

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, Environmental and Social Performance | xv-xvi | Minor point, but is may be worthwhile mentioning that the small grants (both ENRM and SGEF) were supposed to be piloting the work that the Environmental Trust was supposed to carry on. This was proof of concept, plus using our M&E resources like this evaluation, to demonstrate what worked and what did not for the Trust to follow-on or continue. | Thank you, we have added that point into the text. |
| MCC/M&E | xvii | Table ES1 - Evaluation Methods: In the EDR there is more specificity on the methods (i.e. pre/post, interrupted time series). Can this be added to this table?<br><br>Research Questions: If these are the research questions that will be answered in this part of the interim report, this doesn't seem to be the full set of research questions agreed to in the EDR. Suggest flagging somewhere the questions that are answered by the case studies and those that will be addressed in the final report. In general it is best to include all research questions from the EDR and identifying which are being answered at interim vs. at endline. | Because WSM activity implementation was not complete at the end of the compact, we were unable to assess the effectiveness of the activity using an interrupted time series or pre-post design for the interim evaluation. We expect to be able to apply the planned evaluation approach for this activity in the final evaluation report. We previously stated that in a table footnote, but have now included additional information in the narrative, as well as citing the evaluation design report and confirming that all other methodological approaches align with the design report. We also added in information on the research questions from the footnote to the main text. We feel there are too many sub-research questions to list them exhaustively here in the executive summary, so we focused on the main research questions and noted for the reader where all the sub-questions are listed. |

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| MCC/M&E | xix | Summary of Key Findings: For this section, suggest briefly, but explicitly answering the evaluation questions, which should be included as sub-headings. That should make the findings much clearer.<br><br>In addition, can we say the overall finding up front to be clear to the reader? Is it fair to say that there are no results of this activity as of the interim evaluations due to the reasons stated? It should be made clear that the findings on sedimentation are not considered 'evaluative' results of the project at this stage since interventions had not been implemented. This would also be more clear by including the evaluation questions and addressing them in the order -- starting with the findings on implementation. | Thank you, we have revised the executive summary to address these important points. |
| MCC/M&E | xix | Sediment rates: not surprising that these have increased. For the reader who may not get to the WSM section, may want to mention that the dredger was not operational, even at the time of CED (which is mentioned). Plus, our ENRM/SGEF activities were small and would take some time for results even on a small scale to make any impact (trees take time to establish, for example). I would not want to oversell our results or failures. | Thank you, we have revised the executive summary to address these important points. |

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| MCC/M&E | xx | The report notes that "the activity also funded the construction of a sediment disposal area and pipeline to carry dredged sediment from the head pond to the disposal area. These are both still under construction." Important to note here that originally, EGENCO was supposed to supply the disposal area based on the designs provide by MCA-Malawi's Sediment Management Strategy. MCC and MCA-Malawi viewed this as a long-term operational strategy that EGENCO would need to expand. Unfortunately, due to the liabilities inherited from the unbundling from ESCOM, EGENCO was not in a financial position to build the disposal area immediately. MCA-Malawi took over the implementation of the disposal strategy and hired a firm to build the landfill for the disposal area, the pipeline and the associated civil works at Kapichira. Since this work was taken over from EGENCO very late in the compact, it was not completed before the end of the compact, and compact funding may not be used after the implementation period to complete the work. MCA-Malawi's successor agency, MMD, and EGENCO will provide ongoing management and oversight of the activity with the support of a supervising engineer. | We have revised the executive summary to clarify. The details on this issue are presented in the WSM activity results chapter. |
| MCC/M&E | xx | Re Grant Facility findings: Successfully giving out the grants are outputs. As such, can we be a little more careful about framing this as a success? Similarly, the subsequent paragraph states that the grant facility was successful in "achieving its objectives." What were the "objectives" of the grant facility and what is the evidence this was achieved? I only see descriptions in this paragraph of the implementation of the grants, not whether objectives were achieved.<br><br>Also, where the report states, "The facility also succeeded in pushing all grantees to adopt a novel approach toward integrating ENRM and SGEF activities," the context for this statement is not clear. | We have revised the executive summary to address these important points (as well as other sections of the report that make similar points). |

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| MCC GSI | xx | Exceeding targets for some of the SGEF's interventions: Grantees used standardized methodologies that are dominant development approaches in Malawi (e.g. REFLECT Circles and Villages Savings and Loans) that could have facilitated the recruitment of large number of participants | This is true, but was also known at the time the targets were set. |
| MCC, Environmental and Social Performance | xxi | Formal agreement with the Trust: MCC was recently sent an MOU between EGENCO and the Trust to transfer PES money from the tariff. It is worth noting that it was less than half of what was supposed to be provided using the lowest proposal that was sent to EGENCO/ESCOM in preparation for the tariff application. While promising, the MOU amounts are unlikely to cover projected overhead, but may be leveraged to get other support - hopefully. | Thank you, we have revised the executive summary to address these important points. |
| MCC/M&E | xxi | The report states "without continued pressure from MCC, it is uncertain whether the trust will be successfully launched and sustained in the coming years." Note that MCC continues to monitor and engage GOM on the need for EGENCO to commit greater resources to the Trust. That said, MCC may have little influence over such an outcome, nor have much basis to apply "pressure" given that the compact has expired -- the implication of this statement is therefore unclear. | Thank you, we have revised the executive summary to address this issue. |
| MCC/M&E | xxiii - xxiv | The final evaluation will naturally need to address the follow-up questions noted here -- however, this gives the misleading impression that these are evaluation questions agreed to as part of the EDR. Can these sustainability-related issues be conveyed differently here? | Thank you, we have revised the executive summary to address this issue. |
| MCC, Environmental and Social Performance | 3 | Hotspots: There were 10 hotspots identified in the Middle Shire, but MCC divided five and five with the World Bank. Minor point, but it just points to the fact that there were more hotspots identified. MCC's baseline focused on just the five MCA's funding would target. | Thank, we have added a footnote to include this information in the report. |

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| MCC GSI | 3 | SGEF activities: Please add the following: creation and support of already formed Village Savings and Loans, leadership and assertiveness training for women, training on gender equality for traditional leaders, training on business and marketing skills, and promotion of alternative income generating activities. | We have expanded the SGEF activity description. |
| MCC, Environmental and Social Performance | 5 | Program logic: The Trust is an attempt to recognize sustainability issues upfront, knowing that we could not change land-use management (even if the pilot grants) in a five year window. | Thank you, we make this point at the end of the second full paragraph under project logic and theory of change. |
| MCC, Environmental and Social Performance | 12 | Literature Review: Water hyacinth also impacts light infiltration that can change temperature and fish habitat. On an upside, water hyacinth has also been shown to reduce toxins in the water. MCC suspects that this is happening. Testing of the weeds showed a high level of chromium and zinc in the roots and stems. We suspect this was run-off from tanneries or canning, but it limited the use of weeds for green manure, for example. | Thank you, we have added this information into the literature review. |
| MCC GSI | 12 | Literature Review Effectiveness of women's empowerment programming: I suggest to include the following World Bank study on Malawi that is relevant for understanding gaps in productivity and land management and other barriers for women empowerment in Malawi http://one.org.s3.amazonaws.com/pdfs/ONE_Levelling_The_Field_Report_EN.pdf) | Thank you, we have included a reference to this study in the literature review. |
| MCC GSI | 13 | Clarify the source of the following statement "Female-headed households have insufficient resources (especially cash and male labor) to manage their land sustainably—for example, through conservation agricultural methods, including adequate organic and chemical fertilizer applications" | This statement is a topic sentence. The rest of the paragraph provides specific examples and cites to support the main takeaway (see Asfaw et al. 2018 and Place et al. 2001). |

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| MCC GSI | 14 | Clarify the source for the following statement: “show differential outcomes by gender, noting that, in Malawi, male farmers in patrilineal/patrilocal land systems had decision making power over their own land and were more likely than female farmers in matrilineal/matrilocal communities to invest in destumping and tree planting.” | As cited at the beginning of the sentence, Place et al. (2001) is the source for this statement. |
| MCC GSI | 14 | Behavior change: It be would important that the evaluation also helps us to understand to what extent the intervention changes intra-household decision making processes, overcoming traditional division of labor between men and women, and giving women leadership opportunities and inputs to balance productive activities with household care duties | Thank you, this is addressed in the interim evaluation report of the ENRM and SGEF activities, featuring five case studies of the grants. |
| MCC GSI | 14 and 15 | REFLECT Circles and VSL. It is important to clarify that as a result of the SGEF interventions the Compact developed two manuals to strengthen the capacity of the grantees to integrate principles of gender equality and sustainable land management into the REFLECT Circle and VSL methodologies. In April 2017 the MCA Malawi launched the Manual “Promoting gender equality in Environmental and Natural Resource Management. Manual for Reflect Facilitators” and in 2018 the MCA launched “Guidelines for strengthening the integration of Environmental and Natural Resource Management (ENRM) Considerations in Village Savings and Loans Schemes (VSLs)”. These manual were developed in English and Chewa (Malawi local language). | Thank you, we have incorporated that information into the description of the SGEF activity in Chapter I. |
| MCC GSI | 15 | Please include sources for the statements related to training women in business and marketing skills and leadership training for advocacy and lobbying can increase women’s empowerment and participation in land management. | Thank you for catching that oversight. We have now added in the relevant citations. |

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| MCC/M&E | 20 | Can we be more explicit about the methodology of the performance evaluation? | We have now cited MCC's definition of a performance evaluation, referenced the evaluation design report which is aligned with the methods discussed here, and noted the adjustment in evaluation methodology for the WSM activity due to activity implementation delays. We discuss the specific analytic methods for the evaluation in section III.A.3. |
| MCC/M&E | 24 | Cross-evaluation data synthesis - what does this mean?<br><br>Data triangulation: Does this basically mean you are checking to make sure you are hearing a similar story across methods? Does that constitute its own method? | We've further defined cross-evaluation data synthesis in the text.<br><br>Yes, data triangulation is its own analytical method. We've included additional information on this method in the text. |
| MCC/M&E | 25 | Thematic framing: How was the qualitative data analyzed? | We have added additional details on analyzing the qualitative data. |
| MCC, Environmental and Social Performance | 26 | Remote Sensing: Realistically, MCA's projects are so small-scale that you may not see measurable change. One thing we may want to consider is whether MCA areas show slower deforestation or land-use change rates - similar to what is used in REDD projects. Not sure if this would be measure and would require control areas and comparison areas. | Instead of examining land cover change only at the villages undertaking ENRM activities, we wanted to document change over time for the whole basin. We could zoom in to the grantee intervention areas. However, one of the difficulties we face is not having complete knowledge of where people live and where particular activities are performed. We were able to acquire GPS coordinates for the village chief's house, but if reforestation sites are far away, then those coordinates would not yield accurate results. A matched comparison group design would support the analysis the comment describes, and would require village-level data collection from numerous non-treated areas to maximize the chance that a suitable comparison group can be identified. |

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| MCC/M&E | 33 | Can we be a bit more explicit in the Summary of Key Findings? I can't quite figure out if any part of this activity is actually operational. If it is not, suggest stating that up front.<br><br>In terms of analyzing weed growth and sedimentation trends, it's not clear why there was a need to analyze trends since the equipment was not functional at the time of data collection. If appropriate, please flag this as a description of baseline conditions. | We have revised the implementation key findings to clarify that no WSM equipment was in use at the end of the compact.<br><br>This analysis provides a contextual understanding as to the cyclical problems of weed and sediment in the Shire River Basin. The analysis was originally tied to the WSM activity, but implementation was so seriously delayed that the analysis ended up being a description of 'baseline' conditions at the end of the compact. We have revised the text to emphasize these are findings before the WSM equipment was operational. |
| MCC/M&E | 34 | Is the evaluation question on maintenance and repair of WSM equipment answered in this report? Also, for the 3rd evaluation question, the question as stated in the EDR is: What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity? | Regarding the evaluation question on maintenance and repair of the WSM equipment, we provide an interim assessment through our sustainability analysis, including by examining institutional commitment, technical capacity, and resource availability. We will examine this question further in the final report once the equipment is operational.<br><br>We have revised the wording on the sustainability question to align with the original phrasing. |
| MCC GSI | 34 | Increased population density, poverty, and traditional gender roles exacerbated many of these problems. If there is available additional resources to support the statement about the socioeconomic dynamics that can lead to further soil erosion in the targeted area in Malawi. The evaluation uses as source EGENCO staff but it would be important to have additional sources. | We used multiple sources (and cite them) to make these claims, including interviews with EGENCO staff members and the extensive (and multi-volume) environmental assessment report on the Shire River Basin produced by LTS International. |

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| MCC, Environmental and Social Performance | 40 | Scouring: the Sediment Management Plan developed by Fichtner was trying to discourage the use of scouring because of the very damaging impact of this practice on downstream habitat. EGENCO does continue the practice (even in Nkula where the sediments could potentially interfere with Tedzani - may want to confirm if EGENCO continues this practice against Fichtner and MCC's recommendations). | Thank you for your comment, we note the negative environmental implications of scouring in the report. Our final evaluation report will investigate WSM management once the dredging equipment is operational. |
| MCC, Environmental and Social Performance | 41 | Original plan: For the harvester, there was a plan to purchase one new harvester and rehabilitate the older Aquarius. During the bid, this rehab of the old harvester was included in the bid package, but the costs were prohibitive. MCA with MCC's approval decided instead to procure a second harvester. | Thank you, I have added that information to the text. |
| MCC, Environmental and Social Performance | 42 | Cancellation: There was a much more protracted process with the termination of the dredge portion of the contract with JGH for the dredge. Perhaps this is not the place for those painful details, but it explains a lot about the reasons why only one dredge was purchased (short story: much of the funding was locked up in letters of credit held by JGH). | Thank you, we now added in some of those additional details to the text. |
| MCC/M&E | 43 | The report states, “Overall, even though MCC and MCA-Malawi identified the correct technical approach ... the planned activity was delayed and ultimately only partially implemented because of their inexperience in dealing with dredger contractors and their limited capacity to oversee contract management.” Who do you mean by “their” - MCC, MCA-M -- or others (e.g. Fichtner)? Please be clear here. | We have revised the text. |

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| MCC, Environmental and Social Performance | 44 | JGH: Not sure how much we need to go into the JGH situation here, but the details of this case have been documented by OGC in a lessons learned. Much of the delay and ultimate termination was on a letter of credit that JGH insisted be transferable (again speaking to their financial straits). The lack of understanding by MCA on the Letter of Credit and inability to get the banks to work together largely contributed to the delays and eventual termination. Painfully more detail can be provided to Mathematica if they want the whole story. | Thank you, we have now included some of these additional details in the report. |
| MCC, Environmental and Social Performance | 45 | EGENCO: EGENCO did show some flexibility in the re-procurement of the dredge, but not initially. The re-procurement largely came about due to the efforts of MCC's IE support. They hired an expert in dredges and basically re-wrote the bid documents on behalf of the MCA in a short turnaround time. I am not sure I would attribute this to EGENCO. EGENCO had to play more of a role in delivery later. However, even there, they were slow to mobilize until very late in the Compact. Also note that they were supposed to procure and build the DMPA, but EGENCO did not have the funds to do that, and very late again, it came back to MCA to procure the disposal area on their behalf. EGENCO's role was a bit mixed in their performance. | We have incorporated this information into the report. |

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| MCC, Environmental and Social Performance | 46-47 | Trash Barrier: One of the problems with the bid was that the CE did not provide full designs, leaving some of the design to the contractors. MCC had pushed for full designs that would have made the procurement potentially more successful (especially as a fixed price contract). MCC had doubts about the ability of a trash barrier to stop trees, which was EGENCO's concern coming from the previous year's floods. However, one correct: trash barriers were installed on the intakes for weeds, just not the boom that EGENCO wanted for trees. NOTE: MCC was concerned that large logs would still break the trash barrier leading to both the boom and logs crashing into the intakes - potentially making the situation worse. | Thank you for your comment. We have now noted the installation of trash barriers at the intakes for weeds at Nkula. |
| MCC, Environmental and Social Performance | 47 | Weed Harvesters: This was smoother than the dredge, but that largely because Aquarius accepted all the risks of manufacturing and shipping with no payment from JGH. Apparently, Aquarius still has not been paid the final payment for the training and installation of the equipment that JGH was supposed to pay. Aquarius was paid for the equipment, so most of their costs were covered. While better than the dredge, JGH still did not perform well. Plus, the tipper trucks that were JGH's responsibility still arrived late to Liwonde. | Thank you for your comment. |
| MCC/M&E | 51 | Key Findings table: For Implementation, some of these bullets don't seem like findings, rather outputs or recommendations.<br><br>For Objectives, it isn't clear what the exact objectives of the facility were. Can those be stated explicitly so that we know if the facility met the objectives? For example, was it an objective of the facility for it to follow the recommendations of the environmental report? That doesn't seem like an objective to me, but rather an important aspect of the process. | The objectives of the grant facility are defined in the grant facility's policy guidelines document (MCA-Malawi 2014b) and listed in section V.G.1. We added a footnote to that effect to the key findings to clarify. The key findings represent the main answers to the grant facility's research questions for this interim evaluation given the performance evaluation methodology. |

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| MCC GSI | 51 | In the introduction of the Grant Facility it is important to clarify that MCC and MCA developed a Grant Manual in June 2014 which established the framework and operational guidelines for the Grant Facility. | We have added that information to the project overview section of chapter I. |
| MCC/M&E | 52 | The report notes that "Given the delays in implementing the grant facility, MCA-Malawi decided to forgo the concept note stage of the application process." Since the initial call for ideas and selection process is still part of the early stages of implementation, can the report clarify what delays had already occurred as of Jan 2015? Was it in the establishment of the operations manual, or other administrative set up? The call for ideas appears to have happened nearly 1.5 years after the compact entered into force. | There are not specific reasons in our interview data given for the delay in releasing the call for proposals but it seems to be a combination of factors related to setting up the grant facility, developing the criteria for the call for proposals, and conducting outreach. |
| MCC/M&E | 52-53 | Beyond just the number of organizations that applied, can Mathematica provide any assessment or details on the composition of organizations that applied? Additionally, did Mathematica examine how the applicant pool may have changed as MCA-M went about screening and selecting qualified grantees? Later in the same chapter (Section F), the report makes alludes to the fact that MCA-Malawi may have assigned some greater value / weight to domestic NGOs rather than international ones. Is this apparent from the selection process and the original applicant pool? If so, how did this come about, and how did this relate to the quality and capacity of the selected grantees? What other characteristics of applicants were relevant to the selection process? | We reviewed the organizations that applied for the grants but did not feel it was valuable to assess which types of organizations submitted applications. This is (as noted in the report) more than a quarter of the applicants were immediately disqualified due to their failure to meet proposal requirements for formatting, content, and submission date. What was more enlightening was to examine the types of organizations that were ultimately funded and we have now included a new analysis to that effect. Upon further review, the point on the MCA-Malawi focusing on local NGOs was not properly phrased based on the evidence. We have revised that statement. |
| MCC GSI | 55 | WOLREC and CCJP had significant experience in conducting SGEF activities, but they also incorporated some ENRM activities into their programming. Clarify that the integration of ENRM activities was adopted over the course of the implementation, and this changes required adjustment in terms of programming and technical staff. Also, some grantees focused on ENRM adopted SGEF activities during implementation such as FISD and UP. | Thank you, we have revised the text. |

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| MCC GSI | 56 | "MCA-Malawi provided overall technical support by, for example, organizing quarterly meetings with all the grantees to discuss common challenges and distribute materials on interventions such as REFLECT circles." Include the VSL Manual developed by grantees with the lead of MCA and MCC consultants. | Thank you, we have revised the text. |
| MCC, Environmental and Social Performance | 57 | Grant Facility proposal process: Note that Africare was selected initially in the proposals. However, after the submission Africare's DC office came back and insisted on their NICRA being included. This increased their budget considerably and left close to 50 percent of the budget going to admin either in country or in DC. MCA is not a USG entity and is not required to accept NICRA. At a later point, negotiations broke down with Africare and other NGOS were accepted as substitutes (I think two or three others, which accounts for their delayed start date and missing part of the rainy season agricultural period the first year). | Thank you, the budget issue detail is included without naming the specific applicant. |
| MCC/M&E | 57 | The report states that the grant facility structure "supported some activity experimentation in order to expedite the identification of activities that are most effective in reducing sedimentation and weeds in the Shire River basin," but goes on to conclude in the same paragraph that the lack of monitoring data limited the grant facility's evidence base on activity effectiveness. Given this, it seems misleading to claim that the facility truly supported the identification of effective activities, even if it promoted a variety of approaches. | We have edited the text for clarity. |
| MCC GSI | 58 | "Unfortunately, the grantees and MCA-Malawi struggled to collect high quality monitoring data on activity implementation, thereby limiting the grant facility's evidence base on activity effectiveness" For this evaluation it would be very important to understand better the drivers that could have explained the challenges encountered by Grantees in the monitoring and reporting of results. | In the section analyzing implementation process characteristics, we discuss some specific reasons that grantees had a difficult time collecting monitoring data. In section E on grant oversight, we discuss the challenges that MCA-Malawi had in supporting grantees to collect monitoring data. |

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| MCC/M&E | 61 | What does “more beneficial effect” mean in the paragraph on key findings? Should this just say that such targeting is a more cost-effective way of prioritizing areas? | We have revised the text to clarify |
| MCC, Environmental and Social Performance | 71 | Grant monitoring: There is no doubt that MCA did a lot of work to build monitoring capacity in the NGOs. However, very late in the third year of implementation, there were still questions on the reporting quality with inconsistencies internally to NGO reports and between NGOs (making aggregation of results dubious). MCC has some serious reservations about accepting the accuracy of the NGOs' self-reporting. BTW: I do think the comments that MCA was viewed as a donor speaks to the hard work of the MCA grant team in working with their partner NGOs. | Thank you for your comment. |
| MCC GSI | 71 | Grant Monitoring: MCA-Malawi’s grant facility team, with so few staff members, lacked the capacity to oversee such a relatively large grant portfolio. This finding is relevant based on the experience of the Gender and Social Inclusion Director who oversaw the Grant, during the first two years of the Grant Implementation the GSI Director oversaw the Grant by herself which was extremely challenging given that the Director had other responsibilities for the entire Compact. In the last year of implementation for the SGEF activities, the Director had a support from a specialist who exclusively supported the SGEF activities implemented by Grantees. As a result of this staffing adjustment, MCC could see an improvement in the information reported by MCA GSI Director and specialist over the implementation of the SGEF. However, MCC found challenges related to the accuracy and quality of the quantitative results, this could have been explained by the self-reporting mechanism adopted by Grantees. In addition, MCC found that with an additional Specialist to support SGEF MCA-Malawi was able to conduct more site visits and provide more dedicated technical support to Grantees. | Thank you for your comment. |

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| MCC/M&E | 74 | The first paragraph under Programmatic and economic factors touches on several topics but does not clearly convey a single idea or finding. Speaking on the potential to build a body of evidence of successes (or challenges, it should say), the report does not point out that MCA-Malawi was not able to apply rigorous evaluation to the various grants that could have identified and documented such lessons. Regarding the selection of Malawian rather than international NGOs, it's not clear if this was a deliberate choice of MCA-Malawi, as it was partly suspected that the relatively small grant award did not attract any international NGOs into participating or submitting applications; could this have limited the quality and capacity of the applicant pool? The issue of staff burden on MCA has been mentioned elsewhere in the report. | Thank you, we have revised this paragraph. |
| MCC/M&E | 74 | The report makes a point about MCA-Malawi focusing more on Malawian NGOs than international NGOs -- it would be helpful to discuss this in the section of the report focused on the grant selection process (Chapter V, Section A). Was this an explicit part of the selection process, and an explicit weighting by MCA-Malawi in assigning higher scores / values to Malawian NGOs? Or did this come about for other reasons, such as international NGOs deciding not to apply for the grant facility? It would be helpful to understand if this was part of the intent of MCA-Malawi and if it was explicitly incorporated into the facility design / selection process, or if the variety of grant applicants was an observed artifact of the overall scope, structure or process of implementing the grant facility. Also, did it ultimately reflect a strength or weakness of the facility -- what were the pros and cons? | We have included this information in the section on the selection process (see also row 41 for a response to a similar query). |

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| MCC, Environmental and Social Performance | 74-75 | Focusing on the Trust: The idea of focusing on standing up the trust and doing grants through the Trust was the original plan. MCA/CEO was never a supporter of the Trust and wanted immediate pilot grants as a way of demonstrating the concept. However, I do agree that the grant facility got more attention initially and perhaps during implementation than MMCT's initial efforts on the Trust - to the detriment of the Trust's sustainability. | Thank you for your comment. |
| MCC/M&E | 75 | Table V.4. In comparing the current facility design to the execution of the trust (and implementing grants through the trust during the compact), the table suggests that the current facility provides results within a short time period whereas implementing via the trust “takes some time” for results to become visible - this distinction is debatable, and it's not obvious that any intervention dealing with long-term behavior change and adoption of SLM practices would materialize more rapidly under one alternative or another. Similarly, the table notes that the creation of the trust requires “considerable upfront work,” but does not state the same about the grant facility, implying a distinction between the two that may not be justified. | We have now clarified that the main difference in set-up time for the trust (compared to the grant facility) was establishing a sustainable financing mechanism. In contrast, the grant facility already had dedicated funding through the compact. While the grant facility may not be able to necessarily show changes in outcomes over a short time (i.e. land management behavior change), it was able to demonstrate positive outputs. |
| MCC/M&E | 75 | What is the difference in Table V.4 between the current grant facility design and the option of grant making “focused on CBOs”? | Grant making focused on CBOs requires more technical and financial capacity support. The current grant facility model includes larger organizations, including some international NGOs (such as UP, Action Aid, and The Hunger Project) that have more operational capacity. We have added some text to clarify. |

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| MCC, Environmental and Social Performance | 76 | Grants: we did consider doing larger grants with a smaller number of NGOs. I think MCA thought that approach would limit local NGOs from participating. Note that none of the large NGOs participated like CARE, WV or CRS. This would have been less administrative burden and required less capacity building. MCA preferred the small grant and local NGOs approach, with all the burdens that required. It was also supposed to foster a range of approaches and experimentation. However, in the end, most of the NGOs had very similar programs - intentionally in the case of the SGEF interventions. | Thank you for your comment. |
| MCC/M&E | 76 | Regarding grant facilities' potential for providing flexible intervention approaches and working in a more dispersed area, are these features unique to grant facilities - i.e., are they stronger in these relative to other mechanisms - e.g. traditional contracts? What about the comparative strengths of other mechanisms such as contracting - e.g. the potential for stronger oversight mechanisms to manage performance? It would be helpful if this section could draw out a more comparative list of strengths and weaknesses relative to the most likely alternative in the MCC context, whether that be a contracting approach or something else. | The list of alternatives to the grant facility included here is drawn from suggestions by MCA-Malawi and MCC staff during evaluation interviews. No staff member mentioned the contracting approach and so that was not included here for analysis. We can examine this approach further for the final evaluation report. Part of that approach though is encompassed in the subgrant option in the table. Each grantee for the grant facility also signed its own performance contract with MCA-Malawi. |
| MCC GSI | 80 | “MCC exceeded its targets for all SGEF activity indicators, including the number of community members engaged in SGEF activities, part of community- or village-level committees, and participation in REFLECT circles and VSLs (Table V.6)” Clarify this statement regarding MCC involvement in the definition of the targets. I understand targets were based on Grantees' proposals. | The targets we are referring to came from MCC's Malawi compact Indicator Tracking Table at close-out. We have clarified that MCA-Malawi exceeded its targets (since it is the implementing entity). |
| MCC/M&E | 81 | While the report notes that MCA-Malawi was unable to track outcomes related to SLM practices, it was never expected that either MCA or the grantees would have the resources or capacity to rigorously do so - this was always going to be a challenge. | Thank, we have revised the text to clarify. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC/M&E | 82 | "Interventions [to help farmers access markets] could go a long way toward improving farmer welfare and could be addressed by the environmental trust." Perhaps, yet such interventions would be highly multifaceted and more resource intensive than even the ENRM project as a whole, given its scope. | Thank you for the comment. |
| MCC, Environmental and Social Performance | 85 | Trust: As of today (July 2, 2019), the Trust has a signed MOU with EGENCO for funding under the tariff. It is for about half of what was proposed in the three scenario proposal (the lowest target was included in the tariff) and looks to be a one-year agreement, but it is a step toward the money flowing to the Trust. The Trust should be receiving funds as early as next week and has selected Doreen Chanje (from the board) as coordinator. An office has also been identified. | Thank you for the updates. We have revised the text accordingly. |
| MCC, Environmental and Social Performance | 86 | Trust: MCC had developed a TOR to launch the trust set-up immediately from Entry into Force. However, we got push back from MCA, who was doubtful of the Trust and wanted to see upfront NRM activities. Hiring a consultant while the grant facility was set up as a test of concept for grant making was a compromise. MCA still slow walked the Trust feasibility study and then the procurement for the Trust set-up and support. The feasibility study on the Trust was useful, but did cut into the time for setup. | Thank you for your comment. We feel the report covers these important points. |
| MCC/M&E | 86 | Clarify that this concern was in regard to the time remaining after the completion of the study. It seems that an earlier start at establishing the trust, as per MCC's original vision, would have had a higher likelihood of success. | We have made this clarification |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, Environmental and Social Performance | 91-92 | Grant Facility/Trust: Early in cooperative agreement, MCC/MCA had suggested that MMCT's effort take over the grant facility in the second and third year so to have experience in running the facility and a body of work to claim as their own for fundraising. MMCT refused saying that they would set up their own facility, so it kept the MCA facility and MMCT effort separate. | Thank you for your comment. |
| MCC, Environmental and Social Performance | 92 | Trust funding: Part of the reason for the cooperative agreement was to partner with MMCT's consortium on finding funding options. This partnership never really happened because of poor performance and bad relations between MMCT and MCA over time. MCC did try to look at raising money with Coke Foundation, but stopped because of delays in Trust setup at the time. It is worth noting that MCC always supported the PES mechanism, but did not think that any one funding source alone would be sufficient. Admittedly, the endowment was an option we pursued early only to be told that we did not have authority to do an endowment under our regulations. We looked at USAID as a potential option for setting up the endowment, but USAID also lost the authority to set up endowments (which it had previously done with the WB for MEET and MMCT). Unfortunately, MMCT focused almost exclusively on the endowment with minimal support to other fundraising or pursuing the PES. The failure to engage with the tariff process and the PES was one of the final reasons for terminating the cooperative agreement because the window was closing for getting the PES in the tariff. MMCT did little to educate the board on the PES, although it was discussed numerous times when MCC attended the board meetings. As a new concept, it was taking time to get stakeholders onboard. Illovo, an early supporter of the PES, also had management changes, which meant that they were not as engaged in supporting the PES. | Thank you for your comment. We feel the report covers these important points. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC/M&E | 105 | The section on land cover change reads like a description of the status quo / baseline, and doesn't seem to really draw a link with the project. Is that what you intended?<br><br>For the SWAT modeling section, how does this relate to the project? | Have provided additional context explaining the rationale for these analyses and how they relate to the project in Section III.B. |
| MCC/M&E | 115 | Financial resource availability: What about financial resources committed for the trust? This is more critical than the technical capacity noted above related to the trust, as it underpins the technical / operational capacity going forward. | Thank you, we have revised the text to address this. |
| MCC/M&E | 117-118 | Can the table and this summary be part of the Executive Summary? | We have copied this table into the executive summary. |
| MCC, Environmental and Social Performance | 119 | Grants not covering entire ag value chain: completely agree. The hope was that the trust would have on-going funding to take a more strategic approach. However, in talking to the NGOs, it was telling that they did not think in strategic terms and look at marketing options and value chains to incentivize good agriculture practice. Most continued to do extension on conservation agriculture because that is what the government promoted and what they had been doing. Unfortunately, the trust may not have the vision or the resources to take a more long-term strategic approach either. The LTS reports, at least, tried to think more strategically about all the areas needed to tackle land-use change. However, the reports resulted in a complex, interwoven strategy that most stakeholders did not read or could not follow. | Thank you for your comment. |
| MCC, AgLand | xv | "The Millennium Challenge Corporation (MCC) has identified a lack of consistent, reliable, and affordable electricity as a key constraint on Malawi's economic growth." Wasn't identification of this constraint a joint MCC-Malawi effort? In theory the Constraints Analysis and Root Cause Analysis for each compact are "joint ventures." | We have revised the text to address this |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | xv | “To address this issue, MCC and its counterpart in Malawi, the Millennium Challenge Account-Malawi (MCA-Malawi), implemented . . .” MCC is not an implementing entity; MCA-M is responsible for implementing the Compact. | We have revised the text to address this |
| MCC, AgLand | xvi | “MCC and MCA-Malawi established a grant facility . . .” MCA-M established the grant facility with resources provided by the Compact. | We have revised the text to address this |
| MCC, AgLand | xvi | “As part of the ENRM activity, MCC also intended to establish an environmental trust . . .” Again, this would have been an MCA-M responsibility. Using Compact funds to support activities after the Compact End date is not permitted. | We revised the language to “support the establishment of” since MCC had a significant role in establishing the trust. |
| MCC, AgLand | xix | “MCC’s attempt to address this problem by procuring dredging equipment . . .” Do you mean MCA-M? It would have been MCA-M, using Compact funds, that contracted with a vendor for such equipment, not MCC. “The Compact's” would be a suitable replacement for “MCC's” here. | We have revised the text to address this |
| MCC, AgLand | xxi | “MCA-Malawi and MCC struggled to effectively establish the planned environmental trust . . .” It would have been uniquely MCA-M's responsibility to establish said trust. MCC's role is to provide oversight and supervision. The roles are distinct. | We have revised the text to clarify |
| MCC, AgLand | xxii | Title and note for figure are misplaced. | Thank you, we have addressed this. |
| MCC, AgLand | xxii | “MCC and MCA-Malawi were unable to establish the environmental trust . . .” Same issue as above. | We have revised the text to clarify |
| MCC, AgLand | xxiii | Title and note for figure are misplaced. | Thank you, we have addressed this. |
| MCC, AgLand | 1, 1st para. | “MCC identified a lack of consistent, reliable, and affordable electricity as a major constraint on Malawi’s economic growth.” Identification of constraints is a joint MCC-beneficiary country exercise. “MCC’s counterpart” - not sure counterpart is the right word. | We have revised the text to address this |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 3, last para. | "MCC and MCA-Malawi established a grant facility . . ." Same issue as noted above. | We have revised the text to address this |
| MCC, AgLand | 5, top of page | "As part of the ENRM activity, MCC intended to establish an environmental trust . . ." Same issue as noted above. | We have revised the text to address this |
| MCC, AgLand | 5, top of page | " MCC had helped to establish the trust . . ." Same issue as noted above. | We have revised the text to address this |
| MCC, AgLand | 21, Table III.2 | "Staff and consultants who oversaw or participated in implementation of the Malawi compact" Staff and consultants would have had monitoring and oversight responsibilities, but not implementation responsibilities. | We have revised the text to address this |
| MCC, AgLand | 30, Figure III.2 | Bottom portion of figure is confusing. Details of >0.8 Mha total to 1.06 Mha | We have provided additional clarifying text as a footnote. |
| MCC, AgLand | 34 | ACTIVITY appears to be misplaced | We do not see such a misspelling. |
| MCC, AgLand | 36 | Title for Figure IV.1 misplaced | Thank you, we have addressed this. |
| MCC, AgLand | 43 | "MCA-Malawi finally having had to cancel its original contract for the dredgers for nonperformance; " | Thank you, we have addressed this. |
| MCC, AgLand | 43 | "MCC was able to also procure two backhoes and two tipper trucks for Kapichira. For Liwonde, MCC decided to procure . . ." MCA-M, not MCC, would have done the procurement. | We have revised the text to address this |
| MCC, AgLand | 45 | "MCC had never procured dredgers . . ." Procurement would have been an MCA-M, not an MCC, responsibility. | We have revised the text to address this, noting MCC's supporting role. |
| MCC, AgLand | 52 | "MCC and MCA-Malawi commissioned baseline environmental assessments of the Upper and Middle Shire River basins." Any contract signed to do with work would have been signed by MCA-M and not MCC, if financed by Compact funds. | We have revised the text to address this |
| MCC, AgLand | 52 | "MCC and MCA-Malawi identified . . ." MCA-M identified and MCC concurred? | Our evaluation finds that this was done collaboratively between the two agencies. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 54 | “MCA-Malawi conducted a preliminary screen .. .” screening? | Thank you, we have addressed this. |
| MCC, AgLand | 57 | “MCC and MCA-Malawi pushed for certain types of activities based on recommendations from the environmental assessment reports, MCA-Malawi’s and MCC’s preferences, and the grantees’ own experience and technical comparative advantage. They also encouraged grantees to conduct SGEF activities that MCA-Malawi deemed effective, particularly REFLECT circles and VSLs.” These sentences leave the impression that MCC and MCA-M co-managed this activity, which is incorrect. MCA-M is the decision maker, with MCC's “no objection.” | Thank you, we have addressed this. |
| MCC, AgLand | 59 | “implementation. . By . . .” extra period | Thank you, we have addressed this. |
| MCC, AgLand | 67 | Title for Figure V.6 widowed | Thank you, we have addressed this. |
| MCC, AgLand | 72 | “Finally, a unique aspect for MCA-Malawi as a donor . . .” In this context it might be better to refer to MCA-M as the grantor. MCC is the donor in the context of the Compact. | Thank you, we have addressed this. |
| MCC, AgLand | 73 | “MCA-Malawi, MCC, and grantee staff also noted barriers that prevented them from conducting more effective programmatic grant oversight.” The antecedent of “them” should be MCA-M. MCC would not have had a direct role in overseeing the grants as it was not a party to the grants. | Thank you, we have addressed this. |
| MCC, AgLand | 74 | First two paragraphs under F. come close to depicting MCC as an implementer. This is potentially misleading. MCC may have encouraged, even heavy handedly, MCA-M to take certain actions, but MCA-M remained the decision maker, with MCC concurrence. | Thank you, we have revised the text. |
| MCC, AgLand | 75 | “MCA-Malawi and MCC could have pursued several possible options . . .” Same issue; makes MCC appear as a co-implementer, which it is not. | Thank you, we have revised the text. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 76 | ". . .grant facilities implemented by MCC under other compacts . . ." MCC does not implement, it provides funding, oversight and supervision. | Thank you, we have revised the text. |
| MCC, AgLand | 77 | "In Cabo Verde, MCC set up a grant facility . . ." It would have been MCA-CV that set up the facility with Compact funding. | Thank you, we have revised the text. |
| MCC, AgLand | 81 | ". . .to providing support and oversight to the grantees." providing support to and oversight of the grantees. | Thank you, we have revised the text. |
| MCC, AgLand | 82 | "MCC reported that it exceeded its targets for all ENRM-reported outputs . . ." Did you mean MCA-M? | Thank you, we have revised the text. |
| MCC, AgLand | 82 | "Still, MCA-Malawi and MCC reported consistent, positive impressions of the grantees' ENRM work." Sorry to belabor the point, but this implies MCA-M and MCC were co-implementers. | This is based on interviews with MCC and MCA-Malawi staff. We have clarified that we are referring to staff reflections on the grants. |
| MCC, AgLand | 83 | "As one MCA staff member noted, "The thinking is that we scattered the NGOs too thinly over the hotspots or the NGOs had too many activities to do. We did not focus or concentrate efforts in a particular hotspot or intervention" " Yes, I know. Even MCC staff speak in a manner that can leave the impression that MCC is a co-implementer. | We have clarified that this was an MCA-Malawi staff member. |
| MCC, AgLand | 84 | ". . .Shire River basin Management Authority." Basin | Thank you, we have revised the text. |
| MCC, AgLand | 86 | "MCC intended to establish . . ." Establishment of the trust would have been an MCA-M responsibility. | Thank you, we have revised the text. |
| MCC, AgLand | 86 | ", MCC had helped to establish . . ." Would it be more accurate to state that MCC supported MCA-M's efforts to establish the trust? | Thank you, we have revised the text. |
| MCC, AgLand | 87 | ". . . staff members at MCA-Malawi and MCC who managed establishment of the trust." Not MCC's role. | Thank you, we have revised the text. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 87 | “MCC wanted to build a strong sustainability mechanism into the Malawi compact right from the design phase.” Maybe 'wanted to see the Compact include” or something to that effect. “Build” implies responsibility for implementation. | Thank you, we have revised the text. |
| MCC, AgLand | 87 | “As a result, MCC contracted with an environmental lawyer to conduct a trust feasibility study.” Presumably MCC contracted this study with non-Compact funds. Please make that point explicitly. If Compact funds were the source, MCA-M would have done the contracting. | We have revised the text to clarify |
| MCC, AgLand | 87 | Continuation of footnote: “However, MCC terminated the contract . . .” Was this contract funded with other that Compact funds? If so, please make that clear. | We have revised the text to clarify |
| MCC, AgLand | 88 | “MCC and MCA-Malawi decided to contract with an implementing organization . . .” Better to state MCA-M, with MCC's “no objection” or concurrence, . . . MCC would not have been party to a Compact-funded contract. | Thank you, we have revised the text. From our evaluation, MCC had a substantial role in establishing the trust and so we are revising the language to reflect that, while also noting that MCA-Malawi was the ultimate decision maker. |
| MCC, AgLand | 88 | “MCC’s initial procurement for the work failed. MCC received only one bid—and at an unacceptable level of quality. During the second procurement attempt, MCC met with a consortium of stakeholders to encourage them to submit a joint bid that covered the key expertise needed for establishing the trust.” Isn't the actor here MCA-M. Or was this procurement covered by non-Compact funds? | Thank you, we have revised the text. |
| MCC, AgLand | 88 | “One possibility for financing was that MCC could provide seed funding for the trust to create an endowment.” I doubt MCC is the actor here. Isn't MCA-M using Compact funds? | Thank you, we have revised the text. |
| MCC, AgLand | 88 | “MCC was also considering a combination of these approaches to fund the trust.” Or advising MCA-M to so consider. | Thank you, we have revised the text. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 88 | “MCC terminated the cooperative agreement with MMCT.” I doubt very much that MCC had a cooperative agreement with any entity in Malawi. Did you mean MCA-M? | Thank you, we have revised the text. |
| MCC, AgLand | 88 | “MCC redirected staff and consultant time to focus on finalizing the trust’s funding mechanism. “ Again, do you mean MCA-M or each institution redirecting its staff and consultants. | Our evaluation finds that both institution's directed staff time and resources to support the establishment of the trust. |
| MCC, AgLand | 89 | “By the end of the compact, MCC and MCA-Malawi were able to establish the trust on paper and get it officially registered with the Government of Malawi.” It would have been MCA-M that established with MCC support. The Compact is not a joint venture. | Thank you, we have revised the text. |
| MCC, AgLand | 89 | “Even though MCC and MCA-Malawi were able to salvage development of the trust, many challenges remain.” This sentence is misleading for reasons that should well understand by now. At the very least MCA-M should precede MCC, as it is responsible for the Compact's implementation. | Thank you, we have revised the text. |
| MCC, AgLand | 89 | “MCC and MCA-Malawi did achieve key benchmarks in the process of establishing the trust.” Ibid. | Thank you, we have revised the text. |
| MCC, AgLand | 89, Table VI.1 | “MCA-Malawi initially contracted with a consortium led by MMCT that hired a trust coordinator to establish the trust. MCA later canceled that contract for nonperformance and hired a consultant to complete the work.” Bravo! Unlike the text above, this makes clear that MCA-M is the responsible entity. | Thank you. |
| MCC, AgLand | 91 - 92 | “Still, the flexibility and resourcefulness of MCC and other stakeholders did help the trust achieve some initial development benchmarks.” Does this sentence give too much agency to MCC at the expense of MCA-M? | Our evaluation indicates that MCC did most of the heavy lifting here, but we have now included a mention of MCA-Malawi as well to clarify that they are a key stakeholder. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 92 | "• MCC resources and staff support" Again this implies MCC as the actor. | This is an accurate statement. MCC resources and staff support was a key facilitating to help establish the trust. Without strong support from MCC, it is unlikely the trust would have come as far as it has. |
| MCC, AgLand | 92 | ". . . such an approach led MCC and MCA-Malawi to create two grant-making organizations;" MCA-M would have created with MCC concurrence. Each has a distinct role in the process. | Thank you, we have revised the text. |
| MCC, AgLand | 93 | "MCC had not settled on a funding mechanism for the trust during the design stage." Do you mean had not come to an agreement with MCA-M? | Thank you, we have revised the text. |
| MCC, AgLand | 93 | "MCC would provide seed funding for the trust through compact funds." Wouldn't it be simpler to state "The Compact would provide funding . . . | The current text makes it clear that MCC is the funder, which parallels the following sentence where USAID is the funder. |
| MCC, AgLand | 93 | "Although MCC had to reject the endowment approach a few years ago, trust board members continue to bring up some sort of seed financing as a needed first financing step." The context is unclear. Is this specific to Malawi or a more general comment about MCC? | Thank you, we have revised the text. |
| MCC, AgLand | 94 | "MCA-Malawi and MCC were able to rescue trust implementation by rapidly redirecting resources and staff to address the implementation problems." MCC does not have implementing responsibilities. | In this case MCC deployed substantial resources to support trust implementation. Our statement accurately reflects the evidence. |
| MCC, AgLand | 94-95 | " MCC also played a large role in establishing the trust by devoting resources from its head office and contracting with consultants to support establishment of the PES and work closely with EGENCO, ESCOM, MERA, and the GoM." If this was done with non-Compact funds, please make that explicit. | We believe this statement is accurate as is. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 95 | "As noted, with U.S. government agencies legally prohibited from endowing trusts, MCC was unable to rely on the easiest financing option to fund the trust." Wouldn't it have been the responsibility of MCA-M to establish the trust using Compact fund. This statement implies that USAID and MCC operate similarly, which is not accurate. | Our evaluation found that MCA-Malawi was legally prohibited from using compact funds to create an endowment for the trust. |
| MCC, AgLand | 98 | "MCC and MCA-Malawi had assumed most of the responsibility for establishing the trust—a responsibility that now falls on the volunteer board members and staff of MMDT. " Again I think this overstates MCC's responsibilities. At the very least MCA-M should precede MCC. | Thank you, we have revised the text. |
| MCC, AgLand | 100 | Chapter heading misplaced | Thank, we have fixed this. |
| MCC, AgLand | 108 | a) Baseline and b) BAU 2030 look essentially the same. What am I missing? | The changes between the two figures tended to be small enough that districts would not change legend classes from the baseline to the 2030 BAU. We have therefore replaced the 2030 BAU figure with a map depicting the difference in sedimentation between baseline to BAU 2030, and adjusted the accompanying text accordingly. |
| MCC, AgLand | 113 | " . . .MCC canceled procurement of the planned dredger for the Nkula power station." Did you mean MCA-M? | Thank you, we have revised the text. |
| MCC, AgLand | 114 | Repeated use of "MCC and MCA-Malawi" in first paragraph risks leaving the impression that project was a "joint venture," with MCC the senior partner. | Thank you, we have made some adjustments to the text. Note that MCC did formerly report on the grantees through its indicator tracking table and we refer to that here. |
| MCC, AgLand | 116 | Need space between Note and continuation of text. | Thank, we have fixed this. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MCC, AgLand | 117 | "The second compact will not be in the energy sector, but it will give the GoM important political leverage to ensure completion of the first compact's activities." You are much more optimistic than I. My experience is that once a country is eligible for a second compact, it feels less of a responsibility to follow through on the commitments made under the first compact. See Morocco, Burkina Faso for examples. | Thank you, based on your feedback, other feedback, and further analysis, we have revised the language in this statement. |
| MCC, AgLand | 122 | ". . ., MCC and MCA-Malawi were implementing . . ." MCC does not implement compacts. | Thank you, we have revised the text. |
| MCC, AgLand | 122 | ", MCC and MCA-Malawi were implementing . . ." Item. | Thank you, we have revised the text. |

## Table C.2. Stakeholder Comments

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| EGENCO | Acronyms page XVI | Abbreviation list is not exhaustive as some NGOs/Grantees have been left out eg. CICOD, THP etc. | We have added in those acronyms |
| EGENCO | ENRM Activity page 3 (hence also XV) | Include land restoration as an approach that was being undertaken under ENRM Activity | We summarize the activities conducted by the 11 grantees supported by the ENRM activity. |
| EGENCO | ENRM Activity page 3 (hence also XV) | It has to be clear which grantees were implementing ENRM activities and which ones were implementing SGEF activities. Further illustrate if the SGEF targeted all the twelve catchment areas | We state that all grantees conducted both ENRM and SGEF activities and that programming took place in 8 out of the 12 priority catchment areas. |
| EGENCO | Project logic and Theory of Change page 5 | The logic of the project should also touch on food security and improved livelihood as a direct link to community participation in land use management | Thank you, we believe that aspect is covered by the outcomes box that includes “improved natural resource-based livelihoods in priority catchments.” |
| EGENCO | Analysis Overview page 30 | Without the database covering Shire basin farmers, there is need to closely look into the response of the farmers in the World Bank 2017 (LSMS) if they are really practical | Thank you, we looked into using LSMS data but the survey sample sizes would have been too small for the intervention areas and the survey was conducted before grant programming was complete. |
| EGENCO | Summary of Key Findings page 33 | key finding should explain that EGENCO did not have 'adequate' resources to effectively address impacts of weeds and sediment at HEPs. The document has the history behind weed management activities as well as silt management prior to the compact | We include as a key findings: “Before the ENRM project, EGENCO did not have the resources to effectively address the impact of weeds and sediment on hydropower production.” |
| EGENCO | Background on Weed and Sediment Growth Page 34 | Apart from the issues that have been stated on the paragraph, there is need to look into the issue of Kapichira Power Station which right in the middle of Majete Game Reserve. Elephants degrade the soil along the river which gets washed away to the river and hence impacting the pond/reservoir's volume. | Thank you, later on in the chapter we do the discuss the environmental connections between the game reserve and the Kapichira head pond. |
| EGENCO | Implementing the WSM activity at Kapichira Page 42 | The procurement of the Dredger at Kapichira seems to be the lasting solution to the sedimentation at the pond as this will help to reclaim the lost volume | Thank you for your comment. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| EGENCO | Stakeholders and Environmental Factors Page 47 | Looking at the capacity of the backhoe loader, indeed it was not practical to use it to remove sediments from the damping site because of its capacity. | Thank you for your comment. |
| EGENCO | Institution Commitment and Technical Capacity pages 48 (hence also XX) | Verification needs to be done whether the planned capital dredging is for two years or five years. There is conflicting information when compared with the Sustainability Plan -which states two years . | Thank you, we found that the plan was to conduct capital dredging for five year but we will investigate this further for the final evaluation report. |
| EGENCO | Available Financial Resources page 49 | Availability of financial resources for supporting WSM activities is also being hampered by low revenue collection because the customer is not paying in time | Thank you, I have added that into the report. |
| EGENCO | Steps and Implementation of Environmental Trust Page 88 | MCA hired a consultant on the Environmental Trust but the contract was terminated but nothing is said on the way forward on the matter | We clarified that the contract ended because the compact closed in September 2018. |
| EGENCO | Steps and Implementation of Environmental Trust Page 88 | Apart from World Bank's SRBM programme, other donor agencies were approached but the evaluation has not specified why have these donors had fallen out in formation of the trust e.g. UNDP, JICA. | We discuss these issues in the section on prospects for trust sustainability under financial resources and institutional capacity. |
| Training Support for Partners | xxii | Board of Trustees for the Trust was established but the institution was not operationalized since not members of staff were in place at the time of the evaluation. Take note that now the Trust has been operationalized, has a coordinator, bank account has been opened, an MOU with EGENCO has been signed. | Thank you, we have updated the text to reflect this. |
| Training Support for Partners | 75 | Malawi instead of Balawi | Thank you, we have fixed this. |
| Training Support for Partners | Page xiv | Training Support for Partners not Training Support Partners | Thank you, we have fixed this. |
| MMCT | Page xx, Para 2 | Speculation is uncalled for and based upon unclear analysis. | We have revised the executive summary format to clearly show the research question and our interim findings. |

| Reviewer Name/ Institution | Page Number (please reference the number at the bottom of the page) | Comment | Evaluator Responses |
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| MMCT | Page xx, Para 3 | Mention of novel approach but no description or measurement. | This study uses a performance evaluation methodology, as detailed in chapter 3, that analyzes qualitative and quantitative data to provide interim findings on the ENRM project. |
| MMCT | Page xxi, Paras 1+2 | Events to-date cause redundancy to this analysis and commentary denigrates to baseless conjecture. | Reported results are based on a rigorous analysis of the evidence. |
| MMCT | Page xxi | The impact of a marked increased population density and continued climate shocks appears not to have been factored into increased land degradation. | We discuss both of these issues in our evaluation of the weed and sediment management activity (see “background on weed and sediment growth” in chapter IV). We also include climate change scenarios when modeling sediment change in the Shire River Basin (chapter VII). |
| MMCT | Page xxii | ES3 states that across the basin there has been only positive decreases to erosion – this seems to be in direct contradiction to the first statement in the Summary of Key Findings / WSM Activity where ‘we found that sedimentation rates in the Shire River had increased over time. | ES.3 models how sediment yield would change if conservation and land management practices are scaled up in the Shire River Basin to align with government policy. |
| MMCT | Page xxiii | ES4 would benefit from some clarity to the representation of the pie size | We have provided some clarifying text in the footnote, both for the version in the ES as well as in the main text. |
| MMCT | Page 5 | Major assumption expressed here that the Trust would take up support to the prior CSO grantees and further scale-up activities. This approach was not tabled during the development stage. At the outset when the focus was on project finance remnants being used to establish the endowment, the best guestimate of this was a capitalisation of about USD30million. The annual return on investments at a moderate 5% bears no possibility to project finance cost of the 11 CSO’s interventions. | We do not say that the intent of the trust is to fund the same grantee's supported by the grant facility. Instead, we note that, as defined in project documentation and interviews with MCC and MCA-Malawi staff, that the trust is intended to support similar types of activities that were funded by the grant facility. |
| MMCT | Page 5, par 1 | ‘The work to operationalize the trust was transferred to the GoM’s compact follow-on entity….’ There has been no example of this yet experienced in 2019 so incorrect. MMCT extended financial and secretarial | As described in compact close-out documents, MMDT is the official follow-on agency to MCA-Malawi and is formally tasked with supporting completion of remaining compact activities. We noted that MMCT helped finance board |

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| | | support to Shire BEST trustees to continue meetings etc. after closure of MCA whenever requested. | meetings under the sustainability analysis for the trust (section VI.D.2). |
| MMCT | SECTION VI | There is much more detailed analysis that could provide beneficial learning from the circumstances that arose but the superficial overview is difficult to tackle in a few sentences to give direction to what went wrong, and what might have proved positive adaptation to have avoided the end result. | Thank you for your feedback. We disagree that the overview is superficial. |
| MMCT | Page 85, sect 2a | Here it suggested that the type of endowment was a PES mechanism … however for the better part of the contract period the aim was to set-up an endowment trust based on remnant finance of the compact. The PES scheme was very much a secondary finance mechanism once it was establish that MCC was precluded from setting up an endowment. The essential problem was then a time issue to revert to designing and attaining an agreement from EGENCO/ESCOM to a PES scheme during a very transient transformative process of those 2 organisations separating and establishing their new identities. | Thank you for your feedback. We believe the report covers these points, including the miscommunication between MCC, MCA-Malawi, and MMCT on which financing mechanism to focus on. We also note the time constraints. |
| MMCT | Page 87, last para | These few statements grossly over-simplify a complex scenario of fraud and deception, compounded by MCC MMCT staff personality clashes that is still in legal process today, and this weak qualitative summary could be used advantageously against both MMCT and MCA in the on-going court proceedings. | We disagree with this statement. Please see section VI.C.2 on implementation process characteristics, which describes the alleged fraud and litigation. We also discuss the conflicts between MMCT, MCA-Malawi, and MCC in that section. |
| MMCT | General | The evaluator did not understand the conflict originating out of the confusion created from a performance-based contract being awarded and the consequent modalities of financing then being based upon a contradictory ‘grant based’ modality of how finance was then provided. | We disagree with this statement. |

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| MMCT | General | The limited project time scale available worked to the endowment solution as this was within control, but as it became apparent that US policy precluded this, then a change to another financing mechanism brought in extraordinary stress as there were very few organisations capable of generating a funding stream. There was no prior indication of this policy block ahead of time by either MCC or the US & international partners to MMCT so there was no fault lying at any specific door. MMCT was in close contact with BWB, SRWB, Carlsberg, Illovo, and Press Cane as large users of Shire water resources and all were in severe financial difficulties with the exception of the latter which is a small company. In addition, MMCT had built up cooperation with World Bank on two projects very specifically focused on the same area and neither were in a position to assist despite a strong interest to do so. Turning to ESCOM and EGENCO was not an easy pathway to securing finance and the cooperation between MMCT and MCA was not strong enough to combine the political leverage with PES solution-making. This was shown by the fact that MCA despite being a significant donor failed to gain any contracted approval. | Thank you for your comment, we believe the report covers these points. |
| MMCT | General | Did the evaluator discuss project progress constraints with leading international partners such as WCS and IUCN to understand their perspective. That does not come through. There was a high measure of personality conflict ranging through the compact especially when a MCC consultant had very different ideas about milestones and process, to that of both MCA staff and MMCT/partners leadership | Thank you for your feedback. We discuss the conflicts between MMCT, MCA-Malawi, and MCC in section VI.C.2. We did not speak with staff from WCS or IUCN given the short time period of their contract and limited involvement. |
| MMCT | General | Overall, the project was be designed in total isolation to other development programmes, government and CSO activities, and commercial operations in the area, and does not indicate any level of cooperation or cross-learning. Was this project logic? | Thank you for your feedback. We describe the project logic in section I.B. |

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