

# REPORT

FINAL REPORT

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## **Evaluation Design for the Environmental and Natural Resource Management Project in Malawi**

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March 6, 2018

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Thomas Coen	Hua Xie
Arif Mamun	Helen Powell
Claudia Ringler	Jeremy Brecher-Haimson
Ephraim Nkonya	Anca Dumitrescu
Kristen Velyvis	Matt Sloan

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**Submitted to:**

Millennium Challenge Corporation  
875 Fifteenth St. NW  
Washington, DC 20005  
Project Monitor: Jeffrey Garnett  
Contract Number: MCC-16-CL-0007

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**Submitted by:**

Mathematica Policy Research  
1100 1st Street, NE, 12th Floor  
Washington, DC 20002-4221  
Telephone: (202) 484-9220  
Facsimile: (202) 863-1763  
Project Director: Matt Sloan  
Reference Number: 50337.200

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## ACRONYMS

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AAM	ActionAid Malawi
AG CARE	Assemblies of God Care
CA	conservation agriculture
CAPI	computer-assisted personal interviewing
CCJP	Catholic Commission for Justice and Peace
CICOD	Circle for Integrated Community Development
EGENCO	Electricity Generating Company of Malawi
ENRM	Environmental and National Resource Management
ERR	economic rate or return
ESCOM	Electricity Supply Corporation of Malawi
FFS	Farmer Field Schools
FISD	Foundation for Irrigation and Sustainable Development
GBV	gender-based violence
GIS	global information system
GoM	Government of Malawi
HRU	hydrologic response units
IHS	Integrated Household Survey
IRB	institutional review board
ITS	interrupted time series
ITT	indicator tracking table
IUCN	International Union for Conservation in Nature
M&E	monitoring and evaluation
MCA-Malawi	Millennium Challenge Account-Malawi
MCC	Millennium Challenge Corporation
MEET	Malawi Environmental Endowment Trust
MMCT	Mulanje Mountain Conservation Trust
MUSLE	modified universal soil loss equation
NSO	National Statistics Office
REFLECT	Regenerated Frerian Literacy through Empowering Community Techniques
RUSLE	revised universal soil loss equation
SGEF	Social and Gender Enhancement Fund

SHA	Self Help Africa
SLEMSA	soil loss equation model for Southern Africa
SLM	sustainable land management
SWAT	Soil and Water Assessment Tool
THP	The Hunger Project
ToT	training of trainers
TSP	Training Support for Partners
UP	United Purpose
WCS	Wildlife Conservation Society
WE	We Effect
WOLREC	Women's Legal Resources Centre
WSM	Weed and Sediment Management
VSL	village savings and loans

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## I. INTRODUCTION

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Malawi generates 98 percent of its electricity from hydropower, relying primarily on three power plant sites along the Shire River. However, the rapid growth of invasive aquatic weeds limits the free flow of water in the river, leading to costly blockages and breakdowns that interrupt the power supply and reduce generative capacity (Government of Malawi 2013; Lea and Hanmer 2009). Excessive sedimentation in the Shire River reduces active storage at hydropower plants, hindering the ability of plant operators to optimize plant production. Mechanical removal of weeds and dredging of sediment around dams and in head ponds should dramatically improve water flow in the short term, but longer term solutions likely entail engaging upstream communities in improved agricultural and environmental practices that focus on preventing environmental degradation, soil erosion, and fertilizer runoff (United Nations Environment Programme 2013). Economic poverty, population density, and a lack of suitable agricultural land, especially in the Shire River catchment area, have prompted households to cultivate in fragile areas, on steep slopes, and along river banks, creating a challenge for households to change land management practices. Economic poverty is also a cause of deforestation as communities cut down trees for economic gain from charcoal production, meeting the market demand of urban dwellers (Government of Malawi 2013).

To address this problem, the Millennium Challenge Corporation (MCC) signed a \$350.7 million compact with the Government of Malawi (GoM) in April 2011 to develop a more reliable and efficient electricity grid and reduce electrical expenses for enterprises and households across the country. The compact is scheduled to close on September 20, 2018. It consists of three projects: (1) the Infrastructure Development Project rehabilitates and modernizes Malawi's power system; (2) the Power Sector Reform Project undertakes institutional and regulatory reform to improve the regulatory framework and energy policy environment; and (3) the Environmental and Natural Resources Management (ENRM) Project works to reduce costly disruptions and increase the efficiency of hydropower generation by mitigating aquatic weed growth and sedimentation in the Shire River Basin. The ENRM Project—the focus of this evaluation—is comprised of three main activities:

- The Weed and Sediment Management (WSM) activity involves procuring and using mechanical equipment to reduce sedimentation and aquatic weed infestation at the primary hydro-generation sites along the Shire.
- The ENRM activity provides grants to projects designed to reduce soil erosion by improving land management activities in high-priority catchment areas.
- The SGEF activity complements the ENRM activity by targeting women and vulnerable groups to improve their economic and social rights and their decision-making power within their households and communities; SGEF also works with men who have limited control of resources in a matrilineal society.

In addition, the ENRM activity, a part of the ENRM Project, seeks to establish an environmental trust to serve as a sustainable organization to continue funding ENRM and SGEF activities after the compact closes. MCC and MCA-Malawi anticipate that the WSM equipment will also continue to be used effectively after the end of the compact.

Mathematica Policy Research is designing and implementing an independent evaluation of the ENRM Project to determine how the overall project and individual activities help to improve the efficiency of hydropower generation and reduce costly generation disruptions. The ENRM Project evaluation will address research questions on project outcomes, implementation, and sustainability. We propose a mixed-methods evaluation that employs quantitative and qualitative evaluation methods. Table I.1 provides a high-level overview of our proposed evaluation designs for each activity, including primary analytical methods, data sources, and key outcomes.

**Table I.1. Proposed evaluation designs for the ENRM Project**

Activity	Primary evaluation method	Main data sources	Key outcomes
WSM activity	Interrupted time series (ITS)	Administrative data from the Electricity Generation Company of Malawi (EGENCO) and water boards; geospatial land coverage data	Amount and cost of weeds harvested and silt dredged; amount of generation lost and time power plants were offline due to weeds and silt; plant availability; duration and frequency of power outages
ENRM and SGEF grant facility	Performance evaluation	Key informant interviews with grant facility staff and grant program staff; document review; Millennium Challenge Account-Malawi (MCA-Malawi) grant monitoring data	Alignment of interventions with baseline assessment recommendations; level and quality of grant oversight
Individual ENRM and SGEF grants	Case studies	Focus groups and key informant interviews with beneficiaries, program implementers, and staff from relevant government agencies; direct observation of community meetings	Conservation agriculture adoption decisions; women's participation in community meetings and self-reports on labor allocation and decision making within households
Environmental trust	Performance evaluation	Key informant interviews with the Trust Steering Committee, board members, and implementers; document review	Budget projections; alignment of trust set-up with the trust feasibility study
Overall ENRM Project	Soil and Water Assessment Tool (SWAT) modeling; remote sensing analysis	Digital elevation, land cover/use, agricultural land management, soil, precipitation and temperature, streamflow, water infrastructure, irrigation and water withdrawals, and sediment concentration in the Shire River Basin	Changes in Shire River Basin characteristics over time; changes in soil runoff into the Shire if grant activities are expanded

We will conduct two rounds of primary qualitative data collection, contracting with a Malawian data collection firm. The first round, in mid-2018, will assess outcomes near the close of the compact. The second round, in mid-2020, will examine effects of ENRM project activities over a longer time period. Both data collection rounds will include focus groups, key informant interviews, and observational site visits. Although we will not have primary baseline data for this evaluation, we will use data collected by LTS International in its environmental assessment reports, and district- and region-level survey data from Malawi's National Statistics Office (NSO) that were collected prior to ENRM Project implementation. Throughout the evaluation, we will collect and analyze administrative data from MCA-Malawi, Malawian government agencies such as the Ministry of Natural Resources, Energy, and the Environment, the Electricity

Generation Company of Malawi (EGENCO), and non-government entities. We will conduct an integrated data collection approach that coordinates data collection activities across each evaluation to maximize efficiency and reduce respondent burden.

This report describes our evaluation design in detail, including separate designs for each ENRM activity. The report proceeds as follows. Chapter II provides an overview of the compact and the activities we will evaluate, including a description of the project's logic and theory of change. Chapter III presents 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. We then transition to describing our evaluation designs for each activity with a high-level overview (Chapter IV), before presenting a detailed evaluation plan for the WSM activity (Chapter V), the ENRM and SGEF grant facility (Chapter VI), individual ENRM and SGEF grants (Chapter VII), the Environmental Trust (Chapter VIII), and the overall ENRM Project (Chapter IX). Chapter X discusses administrative processes for the evaluation, including data protection and security protocols, a dissemination plan for evaluation deliverables, a description of the evaluation team, and a detailed evaluation timeline.

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## **II. OVERVIEW OF THE COMPACT AND THE ENRM PROJECT**

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In this chapter, we provide context for the evaluation of the Environmental and Natural Resource Management (ENRM) Project by describing the Malawi Compact, the project and its activities, and the mechanisms through which the activities are expected to affect outcomes, as set out in the program logic. We also summarize the ex-ante economic rate of return (ERR) that MCC calculated at the compact level to describe the expected benefits and costs of all compact activities.

### **A. Overview of the Malawi Compact**

On April 7, 2011, MCC signed a \$350.7 million compact with the Government of Malawi (GoM) to develop a more reliable and efficient electricity grid and provide reduced electrical expenses for enterprises and households across the country. The compact went into force on September 20, 2013, and contains three projects: (1) the Infrastructure Development Project rehabilitates and modernizes Malawi's power system (\$257.1 million); (2) the Power Sector Reform Project undertakes institutional and regulatory reform to improve the regulatory framework and energy policy environment (\$25.7 million); and (3) the ENRM Project, the focus of this evaluation, works to reduce costly disruptions and increase the efficiency of hydropower generation by mitigating aquatic weed growth and sedimentation in the Shire River Basin (\$27.9 million). The compact is scheduled to close on September 20, 2018.

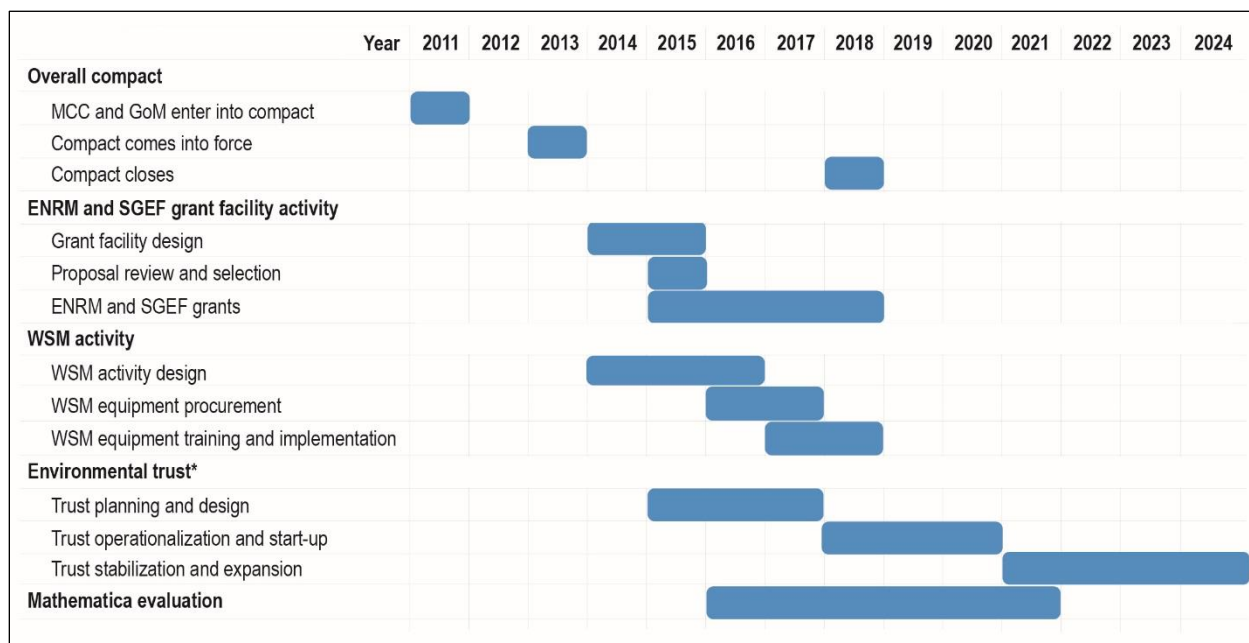
### **B. Overview of the Environment and Natural Resource Management Project**

The ENRM Project focuses on excessive sedimentation and aquatic weed growth in the Shire River that is exacerbated by land use practices. In turn, sedimentation and weeds in the Shire River cause costly disruptions to hydroelectric power plants and ultimately affect the reliability of the electricity supply in Malawi. Hydropower plants produce 98 percent of Malawi's electricity output, and about 90 percent of that power is generated at the three hydroelectric plant sites that are the main focus of the ENRM Project: Nkula, Tedzani, and Kapichira. Three activities of the ENRM Project aim to address this issue: (1) Weed and Sediment Management (WSM; \$15.9 million), (2) ENRM (\$10 million), and (3) the Social and Gender Enhancement Fund (SGEF; \$2 million). In addition, the ENRM Project seeks to establish an environmental trust (as part of the ENRM activity) to fund programs after the compact closes that address sustainable land management and social and gender barriers in the Shire River Basin. Figure II.1 below summarizes the timeline for the ENRM project activities and for Mathematica's evaluation.

**The WSM activity** involves procuring and using mechanical equipment to reduce sedimentation and aquatic weed infestation along key areas in the Shire. Equipment funded by the activity is in the procurement stage, and delivery is expected for use by mid-2018. The WSM activity aims to directly benefit households and businesses through an increased power supply, which will improve electricity reliability and reduce blackouts and brownouts. Additionally, EGENCO staff will be able to learn how to operate and maintain new dredging and sediment removal equipment. This technical knowledge transfer can provide these employees with professional development and it will improve organizational capacity. Under the activity, MCA-Malawi is purchasing equipment for two power station sites along the Shire River, Kapichira and Nkula, and for the EGENCO site at the Kamuzu barrage in Liwonde. Table II.1 highlights the

power-generating capacities of the machines at each power station and the equipment that will be procured.

**Figure II.1. ENRM Project timeline**



\*As described in the Trust Feasibility Study.

**Table II.1. WSM equipment by hydropower station**

Power station/barrage (year commissioned)	Installed capacity (MW)	WSM equipment to be procured
<i>Nkula</i>	124	Trash barrier (1) Dredger (1)
Nkula A (1966)	24	
Nkula B (1992)	100	
<i>Tedzani</i>	92.7	
Tedzani I (1973)	20	
Tedzani II (1977)	20	
Tedzani III (1995)	52.7	
<i>Kapichira</i>	129.6	Dredger (1)
Phase I (2000)	64.8	
Phase II (2013)	64.8	
Kamuzu (Liwonde) barrage (1965, currently being upgraded)	n.a.	Harvester (1) Conveyor system (1) Tipper trucks (2)

Source: ESCOM 2017.

**The ENRM activity** supports grants to projects that reduce soil erosion by improving land management activities in high-priority (or “hot spot”) catchment areas that have been identified in baseline assessment reports as being particularly large contributors to excessive soil runoff in the Shire (LTS International et al. 2010, 2011, 2013, 2014a, 2014b, 2014c). **The SGEF activity** provides grants for programs in these same catchment areas that help women and vulnerable groups engage in more sustainable land use practices and improve decision-making power and social outcomes. The grants also support programming to work with men who have limited control of resources in a matrilineal society. MCC and MCA-Malawi established a **grant facility** to fund ENRM and SGEF activities. Grant programming had to occur within 12 catchment areas (seven in the Upper Shire and five in the Middle Shire) identified in the baseline assessment reports.<sup>1</sup> MCA-Malawi received 55 grant applications and funded 11 projects to be implemented over a three-year period that ends in July 2018. MCA-Malawi has an option to renew grant programming annually and approved all 11 to continue for the second year.

The grants generally include efforts related to soil and water conservation measures, income opportunities to help households move away from unsustainable land management practices, and institutional capacity building for enhanced community-based management. These activities are often complemented by women’s empowerment programs whose activities include conducting business skills training, organizing community REFLECT Circles<sup>2</sup> that often include a literacy development component, and setting up village savings and loan (VSL) groups and environmental management or forestry groups. All grantees conduct activities that meet both ENRM and SGEF objectives; however, some grantees focus more extensively on particular objectives. In terms of location, the approved grantees cover four of the five priority catchments in the Middle Shire and four of the seven priority catchments in the Upper Shire. Four catchments have two different grantees that conduct programming in the same priority area. (Women’s Legal Resources Centre’s [WOLREC] programming spans two catchment areas.) Table II.2 provides summary information on the implementing organization, proposed activities, and location for each of the 11 approved grantees.

**The Environmental Trust** will serve as a sustainable organization to continue funding programs after the compact closes, to support sustainable land use practices and promote gender equity in similar geographic areas. The trust may also serve to monitor changes in land management practices, agricultural area, and deforestation. Through a trust-establishment cooperative agreement that began in January 2016, MCC is investing in the administrative and operational groundwork to have a functioning trust in place by the end of the compact.

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<sup>1</sup> In the Middle Shire, The World Bank and MCC collectively identified 10 priority catchment areas, then split those into two groups. The World Bank focuses on five of the catchment areas and MCC focuses programming on the other five.

<sup>2</sup> REFLECT (Regenerated Frerian Literacy through Empowering Community Techniques) is a participatory technique that supports constructive and open community conversations to address common development challenges.

**Table II.2. Overview of approved ENRM and SGEF grantees**

Implementing organization	Project title and grant size	Subcatchment (district)	Summary of proposed activities
Action Aid Malawi (AAM) <sup>a, b</sup>	Invigorating Gender-Inclusive Environment and Natural Resource Management (\$602,012)	Mwetang'ombe—Lisungwi (Neno)	<ul style="list-style-type: none"> <li>i. Identify lead farmers to carry out mobilization campaigns on woodlot management and other sustainable farming practices.</li> <li>ii. Conduct literacy and gender-equitable ENRM classes.</li> </ul>
Assemblies of God Care (AG CARE) <sup>b</sup>	Enhancing Livelihoods and Resilience of Households in Lingamasa Catchment Area of Upper Shire Basin (\$515,439)	Upper and lower Lingamasa (Mangochi)	<ul style="list-style-type: none"> <li>i. Distribute and plant tree seedlings and sweet potato vines.</li> <li>ii. Conduct training on leadership and sustainable land management.</li> <li>iii. Sensitize communities on environmental degradation.</li> <li>iv. Hold adult literacy classes.</li> </ul>
Catholic Commission for Justice and Peace (CCJP) <sup>a</sup>	Empowering of Communities in the Upper Shire River for Power Generation (\$362,084)	Upper Lingamasa (Mangochi)	<ul style="list-style-type: none"> <li>i. Lobby local leaders to increase women's involvement in agricultural decision making.</li> <li>ii. Conduct trainings on improved ENRM.</li> <li>iii. Distribute fruit seedlings to improve nutrition, provide a sustainable income, and prevent soil runoff.</li> <li>iv. Hold community trainings for women on leadership, business and marketing skills, livestock production, and household planning and budgeting.</li> <li>v. Establish adult literacy and math schools.</li> </ul>
Circle for Integrated Community Development (CICOD)	Machinga-Based Shire River Catchment Biodiversity Conservation and Management Project (\$482,918)	Machinga-Likwenu River Watershed (Machinga)	<ul style="list-style-type: none"> <li>i. Train village committees to oversee ENRM activities.</li> <li>ii. Distribute vetiver grass and construct check dams to slow the speed of runoff water.</li> <li>iii. Plant trees, establish communal woodlots, and distribute seeds for crop diversification.</li> <li>iv. Provide training in forest reserve monitoring, bee keeping, and women's empowerment.</li> <li>v. Establish VSL groups and leaders to support alternative income-generating activities.</li> </ul>
Foundation for Irrigation and Sustainable Development (FISD)	Integrated Approaches to Natural Resources Management and Conservation for Sustainable Hydropower Project (\$688,201)	Lunzu—Linjizi (Blantyre)	<ul style="list-style-type: none"> <li>i. Provide training on tree planting and leadership.</li> <li>ii. Advocate for sustainable land use practices at village government meetings.</li> <li>iii. Establish VSL groups to support alternative income-generating activities.</li> <li>iv. Establish two solar-powered irrigation schemes.</li> </ul>
Self Help Africa (SHA)	Shire Basin Sustainable Natural Resources Management Social Enhancement Project (\$607,147)	Mid Nkasi (Balaka)	<ul style="list-style-type: none"> <li>i. Conduct training on soil conservation techniques, riverbank protection, and gender inclusion.</li> <li>ii. Distribute and plant tree seedlings and pigeon peas to increase income and decrease runoff.</li> <li>iii. Establish VSL groups.</li> </ul>
The Hunger Project (THP)	Titukuke ndi Chilengedwe ndi Magetsi/Growth Through Environment and Electricity (\$519,950)	Mwetang'ombe—Lisungwi (Neno)	<ul style="list-style-type: none"> <li>i. Identify and educate trainer of trainers and local leaders on female empowerment issues.</li> <li>ii. Identify and educate ToT on business and financial management to educate VSLs.</li> <li>iii. Distribute and plant tree seedlings.</li> <li>iv. Provide farmers with conservation agriculture strategies.</li> </ul>



Implementing organization	Project title and grant size	Subcatchment (district)	Summary of proposed activities
Training Support for Partners (TSP)	Strengthening Community Participation in Sustainable Land and Forest Management in the Middle Shire River Basin (\$408,701)	Upper Rivirivi (Ntcheu)	<ul style="list-style-type: none"> <li>i. Sensitize community about relationship between ENRM and power generation.</li> <li>ii. Hold ENRM policy awareness meetings to identify potential policy recommendations.</li> <li>iii. Train women and local leaders on advocacy and lobbying.</li> <li>iv. Construct ridges and plant vetiver grass for water conservation.</li> <li>v. Establish VSL groups.</li> </ul>
United Purpose (formerly Concern Universal)	Improving Catchment and Natural Resource Management for Sustainable Livelihoods (\$836,034)	Upper Chimwalira and Upper Chilanga (Balaka)	<ul style="list-style-type: none"> <li>i. Establish and provide training to user, farmer, and VSL groups.</li> <li>ii. Diversify crop use by providing seeds.</li> <li>iii. Provide adult literacy and leadership training.</li> <li>iv. Conduct meetings to sensitize community members about equal gender relations.</li> </ul>
We Effect (WE) consortium	Smallholder Improvement of Shire River Ecosystem (\$678,862)	Upper Nasenga South (Mangochi)	<ul style="list-style-type: none"> <li>i. Train lead farmers on sustainable ENRM to teach community members.</li> <li>ii. Promote and distribute drought-resistant crops such as cassava and sweet potatoes.</li> <li>iii. Protect riverbanks with trees, vetiver grass, and banana suckers.</li> <li>iv. Lobby village leaders and train community members to institute policies on gender equality.</li> <li>v. Establish VSLs.</li> </ul>
Women's Legal Resources Centre (WOLREC) <sup>a</sup>	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)	<ul style="list-style-type: none"> <li>i. Establish community groups to discuss improved gender equality.</li> <li>ii. Conduct trainings with women on leadership.</li> <li>iii. Conduct trainings with men to champion gender equality.</li> <li>iv. Establish VSLs.</li> </ul>

Sources: Grant proposals, April–June 2016 grant quarterly reports, and MCA-Malawi 2016b.

<sup>a</sup> Grant focuses more extensively on SGEF activities than on ENRM activities. (Other grantees focus more extensively on ENRM activities.)

<sup>b</sup> Grantee began implementation in December 2015. (All other grantees began implementation in August 2015.)

<sup>c</sup> WE leads a consortium of implementing organizations for this grant, which includes the Catholic Development Commission (CADECOM) and the Organisation for Sustainable Socio-Economic Development Initiative (OSSEDI).

The ENRM Project therefore tackles the problem of sedimentation and weed infestation in three ways: (1) removing weed and sediments near hydroelectric power plants (WSM activity); (2) combating the root 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 interventions encompass the project's theory of change, whereby:

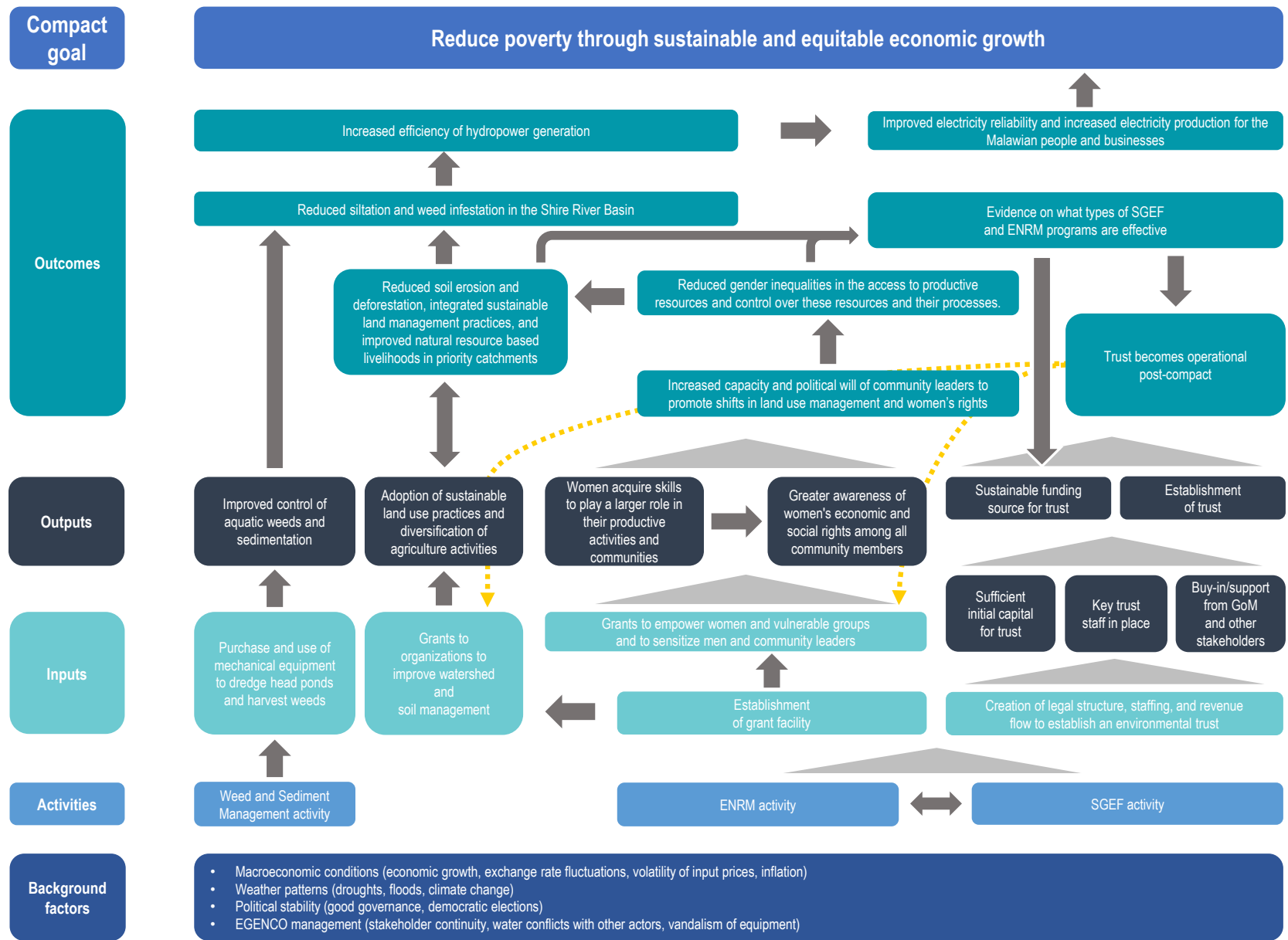
1. If weeds are removed and sedimentation is reduced, then hydropower generators will clog up less frequently and have sufficient levels of water to generate power, resulting in more efficient operation with fewer power outages.
2. If community interventions are implemented, then households and communities will be better equipped to improve land use and watershed management practices, thus decreasing siltation and erosion in the project area.
3. 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 (MCA-Malawi 2014a).

We describe the project logic in detail in Figure II.2, including the background factors that affect project activities and links between 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). 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 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 fundraising to establish operations and in its criteria for selecting grantees. All three activities contribute to the main project outcomes of reducing siltation and weed infestation in the Shire, increasing efficiency of hydropower generation, and improving the reliability and increasing production of the electricity supply.

### **C. Summary of economic rate of return (ERR) analysis**

MCC conducted an economic rate of return (ERR) analysis to determine the number of beneficiaries for the Malawi compact, how much they would benefit from the compact, and how benefits relate to compact costs. MCC estimates that about 983,000 people from 266,000 households will benefit from the Malawi compact activities over 20 years, with estimated benefits of \$567.2 million in net present value, or an average economic benefit of \$577 per beneficiary. Most benefits (68 percent) will accrue to those who consume more than \$4 per day in purchasing power parity (MCA-Malawi 2014c; MCC 2013). The assumptions in the ERR examine power generation, transmission, distribution, and consumption with and without compact activities, but they do not identify the specific contribution that the ENRM Project would make to increase hydropower production. The Malawi compact’s Table of Key Performance Indicators notes that “benefits and beneficiaries are calculated at the compact level only,” and therefore does not provide projected benefits or beneficiaries by compact project or ENRM project activities (MCA-Malawi 2016a). The ERR provides a useful analysis of the compact’s effects, but our evaluation will focus on assessing outcomes specific to the ENRM project and its activities. In that sense, any ex post update of the ERR would not be directly informed by our analysis at the project and activity levels.

**Figure II.2. Program logic for the ENRM Project**



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### **III. LITERATURE REVIEW**

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To provide context for our evaluation of the ENRM Project, we review the existing evidence related to interventions on sustainable land management and its connection to hydropower production, women's empowerment, and grant making—all activities that are part of the ENRM Project. We then describe gaps in the literature and how the ENRM Project evaluation will provide policy-relevant evidence and contribute to the existing literature.

#### **A. Effectiveness of erosion reduction approaches**

Land management practices can improve land cover thereby reducing rain drop impact (FAO 1989) and, in turn, reduce runoff and soil erosion. Soil erosion is a key challenge for sustainable water management and is generally due to land degradation, agricultural practices, and other human activities. Land cover is a critical determinant of soil erosion, and changes in land cover such as deforestation and agricultural practices are important contributors to soil erosion and river sedimentation in many parts of the world. Several soil erosion models have been developed to estimate soil erosion from agricultural land. Erosion models tend to show a linear relationship between land cover and soil erosion (Renard et al. 1991). Prevention of soil erosion through sustainable land management (SLM) practices is a common method for trying to reduce sediment inflow into rivers and hydropower reservoirs (Kondolf et al. 2014). However, only few empirical studies have been done (for example, Randall 2012) to analyze the relative effectiveness of alternative land management practices on the reduction of sediment loading (Annandale 2011).

In addition, analyses have shown a significant potential reduction of sediment loading in river water in response to improved land management in catchment areas. 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 Taimh (2013) found, based on regression analyses in arid areas 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 that minimize soil disturbance, maintain soil cover, and include rotating crops, was originally introduced to control wind and water erosion (Baveye et al. 2011). Many ENRM and SGEF grantees are conducting activities to promote CA. Research shows that CA practices can significantly reduce wind erosion. A study done in Argentina concluded that improving 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 at 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).

CA practices have been widely advocated by the Malawian government, as well as local and development partners, as an important innovation for smallholders to increase yields and reduce soil erosion from wind and rain (Ngwira et al. 2014). Globally, reputable institutions, such as the Food and Agriculture Organization of the United Nations and CIMMYT, have recommended CA

as a promising land and soil management intervention (FAO 2011; Corbeels et al. 2014), supported by success stories of CA in different agricultural settings (Pretty et al. 2011; Ruminamhodzi et al. 2011; Nyasimi et al. 2014). In addition, CA can deliver other ecosystem services such as carbon sequestration; increased soil fertility from decomposition of crop residues; the reduction of pesticides, which pollute water; and the 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). There is no evidence that SLM practices affect the development of the water hyacinth, a weed infesting the Shire River and a focus of the ENRM Project.

Even though appropriate SLM practices can reduce erosion and sediment loading, an important question is how to increase adoption of SLM practices. In addition to traditional agriculture extension approaches, other methods to increase adoption of SLM practices (which have been tested in the field and are being implemented by some ENRM and SGEF grantees) include farmer field schools (FFS) and agglomeration payments for enhanced adoption. A FFS organizes groups of farmers to meet regularly with a trained facilitator to examine the effectiveness of SLM farming practices and how they differ from traditional methods. Davis et al. (2012) showed that FFSs were more effective in promoting SLM practices and in reaching women and less educated farmers, when compared to traditional extension services.

Agglomeration payments provide cash incentives to achieve desired spatial patterns of CA uptake, particularly for contiguity of land use to help address soil erosion challenges. These payments complement conventional encouragements to adopt CA practices. Ward et al. (2016) found that while agglomeration payments can increase adoption of CA, exposure to agricultural production risks, such as flooding and insect infestations, constrains adoption. Moreover, after agglomeration payments end, households may discontinue CA practices.

## **2. Tree planting and forest management**

According to Elliot et al. (1999), soil erosion in primary (undisturbed) forests is generally less than one ton per hectare per year, but erosion can increase to up to 11 tons per hectare per year due to clear-cutting or wildfires. Tree planting is among the most effective strategies in restoring degraded lands and addressing deforestation; it is a component of almost all ENRM and SGEF grant programs. About 97 percent of Malawi's population depends on firewood for cooking (Nielsen et al. 2015). Additionally, trees provide forest cover, which prevents soil erosion, and 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). Between 1990 and 2010, Malawi lost 17 percent of its forest cover of 3.9 million hectares (FAO 2010). Tree planting strategies in Malawi and other countries have faced challenges related to incentives (Nawir et al. 2007). Past tree planting strategies used top-down approaches that required communities to plant trees yet offered no rewards for tree planting efforts (Ostrom 1999). To address these and other challenges, Malawi formed the Village Natural Resources Management Committees' policy to enhance community participation and incentives for tree planting (GOM 1996, 2002, 2010; Wiyo et al. 2015).

On the other hand, community-managed tree planting and natural regeneration have been found to be successful in Malawi. For example, the Uzumara Local Forest Management Board

(LFMB) has a forest reserve that is co-managed by the Department of Forestry and the Uzumara LFMB, and the local community has directly and significantly benefited from the forest (Time 2017). This 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 socio-economic needs of the local community (Le et al. 2012). In addition to tree planting, farmer-managed natural regeneration (FMNR) has been shown to be very successful in sub-Saharan Africa because it is a low-cost practice and consistent with traditional tree management practices (Bayala et al 2014). FMNR allows natural regeneration of native trees and shrubs from mature root systems of previously cleared desert shrubs and trees.

### **3. Fuel-efficient cookstoves**

Adoption of fuel-efficient cookstoves, an ENRM and SGEF grant activity, can reduce deforestation as well as morbidity due to indoor air pollution arising from smoky fuelwood. 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 fuel-efficient cookstoves have been adopted by only 3 percent of the population in Malawi (Nielsen et al. 2015). This is consistent with the low adoption and use of nontraditional cookstoves in the developing world, with the exception of China, limiting any effects on deforestation (Mobarak et al. 2012, WHO 2006, Stinton et al. 2004, Smith et al. 1993). 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). Additionally, government investment in development and dissemination of fuel-efficient cookstoves is quite low—a review showed that only 10 percent of investments in these stoves came from government funding, while 50 percent came from NGOs, 29 percent came from donor-funded projects, and 11 percent came from private sources (Gifford 2010).

### **4. Alternative income generation activities**

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 business skills and marketing training. Agricultural expansion has substantially contributed to deforestation, increasing soil erosion through sole conversion from one to another land use. 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 small or decreased. For example, cropland area and the contribution of agriculture to GDP have been falling consistently in the past 30 years for Botswana, Mauritius, Angola, and the Seychelles. In many other countries, cropland has been expanding, largely replacing forestland—and in turn leading to serious soil erosion (Gibbs et al. 2010; Nkonya et al. 2013).

## **B. Effects of land degradation on hydroelectric production and mitigation strategies**

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, only 2 percent of the rural population is connected to the electric grid; others rely on biomass for energy needs, which can lead to land degradation issues (Taulo et al. 2015).

Soil runoff has adverse consequences for hydropower production. According to Morris et al. (2008), siltation reduces about 0.5 to 1 percent of the global total volume of 6,800 km<sup>3</sup> of water stored in reservoirs annually. The reduction in live dam storage due to siltation reduces power generation (Basson 2004). Additionally, sediments damage turbines and other hydropower plant equipment (Schellenberg et al. 2017). The global annual loss of hydroelectricity generation due to sediment loading into rivers and dam systems is estimated to be US\$6 billion (Basson 2012). Soil and water conservation and other soil erosion control strategies have been proposed to reduce sediment loadings (Kondolf et al. 2014) with success in many countries. For example, a study in Nigeria showed that reforestation and stone bunds reduced sediment yields by up to 66 percent (Adeogun et al. 2016).

Dredging can help recover lost live storage; however, it is very costly and generally seen as a last-resort measure. A study in Nigeria showed that dredging can cost US\$18/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 cost savings due to reduced damage to turbines and other hydropower plant equipment.

In addition to siltation, weeds in riverways also negatively affect hydropower production. Water hyacinth, a perennial aquatic herb (*Eichhornia crassipes*) originating in the Amazon, was first noted in the Shire River in the 1970s but was not considered a problem until the 1980s. Terry (1996) estimated a total mass of water hyacinth of 2 million tons fresh weight (100,000 tons dry weight) for the Lower Shire River. 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.

To address infestation, mechanical, chemical or biological control methods are generally used. Terry (1996) suggests that of the three measures, biological control would be the most cost effective and would likely have the least adverse environmental impact on the Shire River. For effective control of larger outbreaks, all three measures might need to be applied at once. There is some evidence that water hyacinth infestation affects fish production adversely; however, no conclusive study on this could be found for the Shire. Other potentially adverse effects of water hyacinth infestation include increased evaporation, changes in water chemistry, changes in the availability of wetland species, and the creation of a breeding ground for malaria. According to Terry (1996), it is unclear to what extent runoff from agricultural fertilizers affects nutrient composition in the Shire. Intermediate Technology Development Group, citing Harley et al. (1997), suggests that a reduction in nutrients in water bodies should result in a decline in the proliferation of water hyacinth.



### **C. Effectiveness of women's empowerment programming**

Women's empowerment can be defined as reducing the cultural, economic, and political constraints on their autonomy and agency, constraints that manifest 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; increased access or control could represent positive as well as negative impacts on women's lives (Kabeer 2005). Women's empowerment in a developing country context is often considered an instrumental rather than an intrinsic goal; that is, women's empowerment is often looked at for "what women can do for development rather than what development can do for women" (Cornwall 2016). 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).

A baseline gender and social assessment was conducted by LTS International to identify and assess potential economic, social, and gender differences and inequalities. These differences and inequalities may affect land use practices; access, control, and/or use of natural resources; or the decision making of key actors, such as smallholder farmers and other natural resource users in the ENRM Project area (LTS International et al. 2014c). According to the baseline assessment, gendered access to and control over agricultural assets vary substantially between men and women in the upper and middle regions of the Shire River Basin. Access and control are lowest for female-headed households. Moreover, due to 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 sustainably manage their land—for example, through conservation agricultural methods, including adequate organic and chemical fertilizer applications. Moreover, within the matrilineal system, although women hold the land rights, men make most of the agricultural decisions. However, men reportedly have reduced 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 land rights, women are prevented from sustainably managing agricultural lands. Differential outcomes by gender are shown by Place et al. (2001), who found 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 de-stumping and tree planting. Gender inequalities in the distribution of power shape the outcomes even when land ownership is equal.

Given the extent to which women, particularly poor women, have been marginalized in processes by which development policies are designed and implemented, identifying gender issues before implementation and using the results to shape the use of the MCA-Malawi SGEF appears to be a promising step in improving women's control and natural resource management. How this fund attempts to strengthen women's capacity for voice and action at different stages of the planning cycle will be important to understand through our evaluation. A number of activities have been funded to support women's empowerment and land management. Group-types known to be empowering have been suggested as structures through which some of the interventions will work. In addition, it is important to understand for this evaluation the extent that 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.

### **1. REFLECT Circles**

One of the group-types suggested 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 people together to discuss issues the participants identify as important, ensuring that people's voices are heard equally and that they 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. REFLECT Circles have been used in more than 70 countries (Reflect 2009), and in this project they are used to empower women and enhance communication between women and men to manage land more jointly and sustainably. REFLECT Circles work through education for empowerment. They have helped women learn about their rights and build the strength to use their knowledge to assert their rights around the world (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 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). In India, REFLECT Circles were used to deal with drought in a very poor district. Drought was seen as a political issue, relating 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 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**

Village savings and loans (VSLs) constitute a decentralized, non-institutional, 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). Many SGEF grantees are working in communities to establish VSLs. They are a relatively common development intervention in Malawi, and among other benefits have been seen as a catalyst for improved gender relations, women's leadership, and community development.

Recent rigorous evaluations of VSLs showed very little impact on individual empowerment and community engagement, contradicting previous findings, although, the results could be due to how survey questions were framed to measure these outcomes (Gash and Odell 2015).

VSLs are also seen as effective platforms for supporting other development services, in that programs can be designed to be delivered to members through the group. Evidence to support this 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 and build capacities to sustainably harvest and sell forest products through village savings and loans (CEPF 2015). Other similar projects include one in Niger that supports women learning new skills so their communities can become more resilient to climate change while investing in VSLs (Guilbert 2017), and one in Ghana that addresses issues of environment and natural resource management and the formation of VSLs to pool savings and make investments to protect natural resources (Futukpor 2016). However, the evidence that VSLs are welfare enhancing is thin, as rigorous research has been funded only since 2008.

### **3. Other SGEF activities**

Another structure through which SGEF interventions are being conducted is training, including in literacy, business and marketing skills for women, and leadership (for advocacy and lobbying). Adult functional literacy and numeracy have long been seen as processes 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). Business and marketing skills training for women can promote their economic empowerment, and this training has been supported by many development organizations and private sector organizations. Giving women the skills to expand their economic options has often been used as a method for empowerment. Finally, leadership trainings for advocacy and lobbying are suggested to increase empowerment and participation of women in land management. Advocacy and lobbying training is seen as a means to build civil society's capacity to influence decision makers and provide participants with the tools they need to effectively lobby for policies that are important to women. Such leadership training has been used in many areas, such as health and welfare, political participation, labor, and human rights. As women continue to be underrepresented in leadership positions across political, social, and economic spheres, the gaps in women's leadership undermine women's rights as well as sustainable development. All three of these types of trainings can give women the skills to improve gender inclusion in civil society.

Finally, grant activities to improve joint decision making may focus on community engagement and sensitization of men on equal gender relations. As noted, unless changes occur in cultural norms and men's and women's consciousness, any changes in the roles or resources women attain may not improve the quality of their lives and may not be sustained. However, true changes in norms—brought about by increasing women's decision-making authority, a key goal of the grant facility—can improve women's lives outside the home and the balance within household decision making.

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

To design an effective, efficient, and sustainable grant-making program for the ENRM Project, it is important to examine lessons from other donor-driven programs, many of which failed following project closure (Swidler and Watkins 2009). This section examines the drivers of successful financing as well as challenges faced in grant making for sustainable natural resource management.

Environmental trust funds in sub-Saharan Africa have been one of the most common programs. Bladon et al (2014) reviewed 12 conservation trust funds in developing countries and concluded that the major drivers of their success were the following:

- Strong feasibility studies
- Diversified financing
- Strategic and financial planning
- Strategic partnerships
- Political support
- Financial expertise
- Strong reporting, monitoring, and evaluation

Smith and Johnson (2014) also emphasize the importance of evaluation and analysis as key 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. The support enhances sustainability and encourages learning and reflection. However, the external support should be designed with an exit strategy to ensure that the grantees graduate from such support. Additionally, Dear (2016) suggests that donors, beneficiaries, government, and other key stakeholders need to understand the risks, be ready to share 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 needed to address evolving challenges. Finally, organizational and capacity development of grantees is a further factor of success.

The challenges are closely related to factors of successful grant making. Lack of quantitative data for evaluation and analysis is one of the key factors that determine success and effectiveness. Related to this, lack of information management systems is a key challenge (Chléirigh 2015). The low capacity of grantees to handle a variety of complex projects also remains a key 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 are limited socioeconomic studies on the impacts of water hyacinth growth on hydropower generation. No empirical evidence was found on the linkage between fertilizer use and water hyacinth infestation levels. There is also limited

evidence on the efficacy of many programs seeking to address social and gender barriers. Our evaluation will add to the literature on these activity areas as well as provide comparisons for types of training and intervention methods by comparing results across grants.

The ENRM Project evaluation will also provide important learning 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. The country's growing energy needs and its energy policies are putting additional pressure on power generation and distribution. 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 2015). It is 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 high costs 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 (by Malawian policy makers) on effective land management interventions and natural resource programs that can alleviate erosion and sediment yields in the Shire River, the main catchment basin in the country. While this evaluation will not provide any causal evidence on these interventions, it will provide an understanding of why communities do or do not adopt certain land management techniques and the key factors in their decision-making process. We will focus on both prevention and alleviation of siltation from upstream land management practices and on rehabilitation (dredging) efforts.

Through in-depth case studies, the evaluation will provide qualitative evidence of the erosion and sediment reduction potential of various land management practices under different catchment conditions. This information will be useful in providing guidance to stakeholders involved in the Shire River Basin management, 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 will also fill information gaps on the efficacy of SLM practices, particularly informing the Environmental Trust, the Malawi government, donors, and other project stakeholders on 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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## IV. EVALUATION DESIGN OVERVIEW

### A. Overview of evaluation strategy

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. For each activity, we propose the most rigorous and feasible evaluation design to answer our project research questions, given constraints on data, activity timing, and the structure of the intervention. We will implement an integrated data collection and analysis approach that leverages data sources from one activity evaluation for use in another activity evaluation. Table IV.1 summarizes the research questions for each activity, the proposed method to evaluate each question, the data sources we will use for that evaluation, and the key outcomes we will report on (as applicable). The method listed is most rigorous evaluation method proposed for that research question. As appropriate, we will also incorporate qualitative data to contextualize quantitative findings. In subsequent chapters of this report we describe in detail our proposed evaluation design and analytical approach for each activity and the overall project.

**Table IV.1. ENRM Project evaluation summary**

Research questions	Method	Data sources	Outcomes
<b>Weed and Sediment Management evaluation</b>			
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? c. Did the equipment purchased perform as expected in terms of the quantities of sediment dredged and weeds harvested?	Performance evaluation	Project implementation and monitoring documents; key informant interviews with MCA-Malawi, EGENCO staff; power station site visits	
2. To what extent did the activity restore active storage at the hydropower plants during the compact and after it ended?	Interrupted time series (ITS)/pre-post	Administrative data from EGENCO and the Blantyre and Southern Region Water Boards; weather data from national meteorological services; high spatial resolution mapping data	Amount of weeds harvested and silt dredged; costs of weed management and sediment removal; plant availability; ; surface area of head ponds covered by weeds
3. Did the new weed harvesters and dredgers affect power plant operations during the compact and after it ended? a. To what extent did the equipment change power generation? b. How did the use of the equipment and related improvements vary by hydropower plant?	ITS	EGENCO administrative data; weather data from national meteorological services	Generation lost and energy not produced due to weeds and silt by power station; plant availability; duration and frequency of turbine outages by power station
4. How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity?	Performance evaluation	Project implementation and monitoring documents; key informant interviews with MCA-Malawi, EGENCO staff; power station site visits	Functionality of equipment

Research questions	Method	Data sources	Outcomes
5. What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity?	Performance evaluation	Project implementation and monitoring documents; key informant interviews with EGENCO staff	
<b>ENRM and SGEF grant facility evaluation</b>			
1. How was the grant facility activity implemented? a. Was the grant facility implemented as planned? Why or why not? b. Which implementation factors supported or hindered the effectiveness of the grant facility? c. 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? d. Was the 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? 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?	Performance evaluation	Grant evaluation criteria and ranking process; proposals of selected and non-selected grantees; interviews with grant program staff and MCA-Malawi grant facility staff; baseline environmental assessment reports; grant facility documentation	Alignment of interventions with baseline assessment recommendations; level and quality of grant oversight; grant proposal re-scores
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?	Performance evaluation	Key informant interviews with grant program staff and MCA-Malawi grant facility staff; grant quarterly and final reports; grant monitoring data; MCA-Malawi internal evaluations	
<b>Individual ENRM and SGEF grants' evaluations</b>			
1. Which intervention was implemented and what was the program logic underlying it?	Case study	Key informant interviews with grants program staff; grant proposals	
2. How was the program implemented? a. How did implementation change from what was planned and why? b. Which implementation factors supported or hindered the completion of the intervention?	Case study	Grant progress reports; MCA-Malawi monitoring data; key informant interviews with grant program staff, relevant government employees, and MCA-Malawi grant facility staff	



Research questions	Method	Data sources	Outcomes
<p>3. To what extent did the intervention lead to adoption of conservation agriculture and land management practices by farmers and communities?</p> <p>a. Which land management practices are more readily adopted by farmers and communities, and why? Are there differences in adoption between male and female farmers?</p> <p>b. Is it possible to differentiate between effective training approaches and practices that farmers are predisposed to adopt? If yes, are certain training methods associated with greater farmer adoption? Are different training methods associated with better results for male and female farmers?</p> <p>c. What was the relationship, if any, between ease of adoption, farmers' perceptions of effectiveness, and farmers' tendency to adopt different practices?</p>	Case study	Site visits, key informant interviews with community leaders and grants program staff; focus group discussions with program beneficiaries; MCA-Malawi monitoring data	Adoption decisions of sustainable land management practices and participation in alternative income generating activities
<p>4. To what extent did the intervention affect gender roles in the household and communities?</p> <p>a. To what extent did the intervention lead to greater joint household decision making regarding land and natural resource management and household finances?</p> <p>b. To what extent did the intervention lead to changes in division of labor on the farm and at home?</p> <p>c. To what extent did the intervention lead to leadership opportunities for women? To what extent did the intervention promote female-headed household involvement in community decision-making?</p>	Case study	In-depth, one-on-one interviews with female beneficiaries, particularly female heads of household; observation of community development council meetings; focus group discussions with program beneficiaries; MCA-Malawi monitoring data; key informant interviews with community leaders and grants program staff	Women's participation in community meetings; women's self-reports on division of labor and decision making authority within a household
<p>5. Were grants that focused more on ENRM or SGEF activities more or less effective than grants that targeted both types of activities?</p>	Case study	Site visits, key informant interviews with community leaders; focus group discussions with program beneficiaries; MCA-Malawi monitoring data	
<p>6. What are stakeholders' perceptions of the sustainability of grant activities to improve sustainable land management and address social and gender barriers? What factors were driving beneficiaries to continue to adopt SLM practices?</p>	Case study	Key informant interviews with community leaders; focus group discussions with program beneficiaries	

Research questions	Method	Data sources	Outcomes
<b>Environmental Trust evaluation</b>			
1. What implementation factors supported or hindered the establishment of the trust?	Performance evaluation	Key informant interviews with trust steering committee, board of directors, and program implementation staff; trust document review	
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 fundraising strategy to achieve sustainable financing over the long term? How was it developed?	Performance evaluation	Key informant interviews with trust steering committee, board of directors, trust organization, MCA-M, and program implementation staff; trust document review	Budget projections
3. How did leaders of the implementing consortium use their organizations' experiences to establish the trust? a. What lessons did these leaders draw from their own grant-making experience that they applied to the establishment of the trust?	Performance evaluation	Key informant interviews with senior managers from trust establishment consortium	
<b>Overall ENRM project evaluation</b>			
1. How has land use along the Shire River changed during the ENRM project?	Remote sensing analysis	High spatial resolution mapping	Land cover and use classification
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?	Soil and Water Assessment Tool (SWAT) modeling	Digital elevation, land cover/use, agricultural land management, soil, precipitation and temperature, streamflow, water infrastructure, irrigation and water withdrawals, and sediment concentration in the Shire River Basin	Changes in soil runoff into the Shire and hydropower production
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?	Performance evaluation	Project implementation and monitoring documents and interviews with stakeholders derived from activity-level evaluations of program implementation	
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 consequence of the program (positive or negative)?	Performance evaluation	Findings from each activity-level evaluation and results from the SWAT modeling; MCC project documentation including compact close-out documents; interviews with program implementers and MCA staff; MCA program monitoring data	Electricity generation; plant availability; household income; SLM adoption

Research questions	Method	Data sources	Outcomes
<p>5. Based on the results of each activity's evaluation, what are stakeholders' perceptions of sustainability of outcomes achieved under the ENRM project, and why?</p> <p>a. What could or should be done to increase sustainability?</p>	Performance evaluation	Project implementation and monitoring documents and interviews with stakeholders derived from activity-level evaluations of program sustainability	

## B. Data collection across evaluation components

We plan to conduct two rounds of qualitative primary data collection as part of the evaluation of the three activities under the ENRM Project—the WSM activity, the grant facility (including case studies of five individual grantees), and the Environmental Trust—as well as for our overall evaluation of the ENRM Project. After contracting with a Malawian data collection firm, we plan to conduct the first round of data collection in mid-2018, likely after the main harvest (in April/May 2018) in order to assess outcomes near the close of the compact. We propose completing the second round of data collection around the same time of the year in mid-2020 to examine effects of ENRM Project activities over a longer term. Both data collection rounds will include focus groups, key informant interviews, and observational site visits. The exact timing of data collection may vary for each grant evaluation depending on whether we are assessing planting techniques or the extent of winter cropping.

Data collected will often be used for multiple evaluations. Given the overlap in data sources across activity evaluations and the fixed costs of data collection, we will collect the data simultaneously across activities to meet the needs of the evaluation in an efficient manner and lessen the burden on the respondents. We will identify the data sources and respondents for each activity, look across activities to determine common sources and respondents, and coordinate to collect the required data most efficiently with the least burden on the respondent. This will include bundling administrative data requests to government agencies instead of submitting separate requests for each activity evaluation. Since some data sources will be used by multiple activity evaluations (such as key informant interviews with grants program staff for the grant facility and individual grants evaluations), we will draft interview protocols that incorporate key questions relevant for both evaluations and interview respondents only once per data collection round.

## C. Crosscutting evaluation risks and limitations

We have identified risks and limitations to our proposed evaluation designs, as well as mitigation strategies to address these risks. In each activity design chapter, we discuss the risks and limitations specific to that evaluation design. Some risks and limitations cut across specific evaluation activities, and we present them here.

**Challenge in the collection of qualitative data.** For qualitative data collection, ideally the researchers involved in designing the protocols and analysis of the data would conduct the interviews and focus groups; this would facilitate appropriate probing and allow the interviewer to adapt the interview as new information is learned. Our ability to carry out qualitative data collection in an ideal manner will be limited due to the need to partner with a local data collection partner. To overcome this challenge, we will work to engage the data collectors in

discussions about the study design, protocol development, and analysis; at the same time, we will incorporate the Mathematica team into the data collection process to the extent possible. This will ensure mutual investment in conducting the evaluation, as well as improve the quality of the data collected and the interpretation of the findings.

**Timing of the first round of qualitative data collection.** We are planning to conduct the first round of data collection in mid-2018, before the end of the compact, to ensure the availability of key MCA-Malawi staff and other project stakeholders, including EGENCO staff who are involved with implementation of the WSM activity, SGEF and ENRM grants program staff, and Environmental Trust steering committee members. Delays to this data collection could result in the inability to gather certain data. We will work closely with MCA-Malawi to plan the data collection in a timely manner and adjust the schedule as needed to ensure availability of the respondents.

**Stakeholder availability for the second round of qualitative data collection.** We are planning to conduct the second round of data collection in mid-2020, two years after the end of the compact. MCA-Malawi is expected to be closed out by that time. Given the length of time, there may be staff turnover among key stakeholders such as EGENCO and SGEF and ENRM grantees; also, staff availability for data collection purposes might be limited because the project would have ended. In anticipation of this potential challenge, we will build rapport with key stakeholders by engaging them throughout the evaluation. This engagement will include providing regular updates, sharing evaluation documents for their review, staying in touch through our local consultant, regularly collecting updated contact information, and having other evaluation team members meet them when they are in Malawi. We will also keep the lines of communication open and ensure that stakeholders remain invested in the long-term evaluation of the ENRM Project.

**Gender sensitive surveyors.** A key part of the evaluation involves conducting interviews with female beneficiaries and asking them what could be sensitive questions involving household decision-making, management of household finances, and gender roles in their community. To ensure the data collection team is properly trained to address cultural and gender sensitivities, all surveyors will undergo gender sensitivity training as part of the data collection training. We will also ensure the survey team has a mix of both male and female surveyors. Focus groups with female beneficiaries will be led by female surveyors.

## **V. EVALUATION OF WEED AND SEDIMENT MANAGEMENT ACTIVITY**

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The WSM activity involves purchasing and using mechanical equipment—such as dredgers, weed harvesters, conveyors, and disposal trucks—to reduce weed infestation and sedimentation at the Liwonde barrage and near the hydroelectric power stations along the Shire River in Nkula and Kapichira. Our evaluation will examine the effects of this activity on weed infestation and sedimentation in the head ponds of the power plants, and the resulting changes in hydroelectric power availability and reliability. In this chapter we describe the evaluation approaches for the WSM activity, including the key research questions, the analytic approaches, and risks and challenges.

The evaluation of the WSM activity will utilize an integrated, mixed-methods approach that includes quantitative and qualitative data analysis. The evaluation will address six key research questions and related sub-questions, which we have grouped into the following categories.

### *Implementation analysis*

- 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?
  - c) Did the equipment purchased perform as expected in terms of the quantities of sediment dredged and weeds harvested?

### *Impact analysis*

- 2) To what extent did the activity restore active storage at the hydropower plants during the compact and after it ended?
- 3) Did the new weed harvesters and dredgers affect power plant operations during the compact and after it ended?
  - a) To what extent did the equipment change power generation?
  - b) How did the use of the equipment and related improvements vary by hydropower plant?

### *Maintenance and perceived sustainability*

- 4) How do the power plants ensure appropriate maintenance and repair of the equipment provided under the WSM activity?
- 5) What are stakeholders' perceptions of the sustainability of outcomes of the WSM activity?

To address these research questions, we will conduct an impact evaluation using an interrupted time series (ITS) design combined with a performance evaluation using a pre-post design and qualitative implementation analysis. The impact analysis will enable us to provide quantitative estimates of the impacts of the WSM activity on key outcomes related to the operations and productivity of the hydropower plants, and to explore variations in impacts across hydropower plants (questions 2 and 3). The performance evaluation using qualitative and quantitative data will enable us to answer questions not amenable to an impact analysis—that is, assess how successfully the activity was implemented, which will provide important context for

interpreting the findings from the impact analysis and allow us to reflect on maintenance and perceived sustainability (questions 1, 4, and 5).

## **A. Quantitative approaches**

The quantitative approach will involve both an impact evaluation using an interrupted time series (ITS) design and a performance evaluation using a pre-post design.

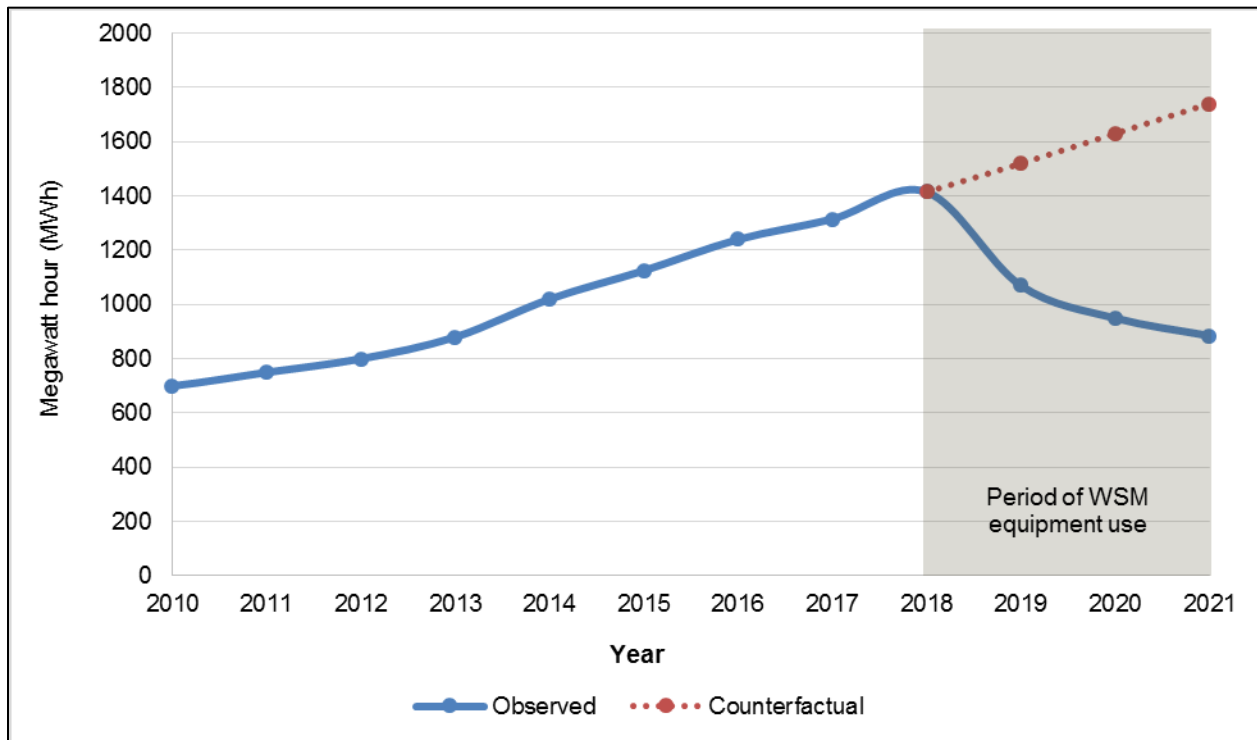
### **1. Impact evaluation: ITS design**

The ITS approach requires outcome measures that are available at regular intervals (that is, multiple data points) to establish trends before and after the activity and measure impacts on the outcomes of interest. The ITS estimation approach will credibly attribute changes in project outcomes under the following circumstances. First, no other major changes that could also affect outcomes occurred at the same time as the project. Second, to establish a trend, data on outcomes must be available for multiple points in time before the implementation of the project. Last, the trend established by the pre-implementation data must be clear enough to predict post-implementation outcome levels in the absence of the project.

The counterfactual in the ITS design is driven by the projection of the trend established for the period before the activity is implemented. Thus, the impact of the activity on key outcomes will be measured by calculating the difference between levels that would have been predicted based on the pre-implementation period trend in the absence of the project, and the actual outcome levels observed in the post-implementation period. The availability of multiple time points is particularly important in the context of the WSM activity because of the seasonality of water flow rates in the Shire River and their impacts on weed accumulation close to power stations and on hydroelectricity generation (Government of Malawi 2013).

Figure V.1 provides a stylized example of the application of ITS analysis to estimate changes in electricity not produced by the hydropower plant due to weeds and sediment. Because the trend line prior to the project period shows a steady increase in loss of electricity production, we can forecast that the loss would continue to increase in the absence of the WSM activity (the counterfactual), which is depicted in the figure by the dotted line. The decrease in electricity not produced from the use of the WSM equipment is also shown in the figure, and the difference between the dotted line and the line for the period of WSM equipment use captures the estimated impact. The estimated impact is a larger change from the counterfactual prediction than would be measuring the change compared to the period preceding the WSM equipment use. In reality, the trends likely would not be as smooth; however, pre-program data must demonstrate a clear trend.

**Figure V.1. Illustrative ITS analysis: change in electricity not produced due to weeds/sediment**



To more accurately estimate changes in outcomes related to the WSM activity, we will use a regression framework that controls for other time-varying factors that could have influenced outcomes. Establishing a clear trend line for key outcomes prior to the activity implementation, while controlling for time-varying factors that may influence outcomes, will allow the ITS approach to attribute changes in outcomes to the project activity. We will use linear regression of the following form to estimate impacts using the ITS design:

$$Y_{it} = \beta_0 + \beta_1 Time_t + \beta_2 Post_t + \beta_3 Time_t * Post_t + \beta_4 X_{it} + \varepsilon_{it}$$

where  $y_{it}$  is the power-plant-level outcome of interest measured at plant  $i$  at time  $t$ ;  $Time_t$  is the time since the start of the data-collection (and  $\beta_1$  capturing the influence of the time trend);  $Post_t$  is a binary indicator for the time period when the equipment the WSM activity is delivered and operational;  $Time_t * Post_t$  is the time since the equipment provided under the WSM activity became operational;  $X_{it}$  symbolizes other control variables which may help explain some of the variation in the outcomes; and  $\varepsilon_{it}$  is a random error term. The coefficients of interest are  $\beta_2$ , which gives us the “change in level,” and  $\beta_3$ , which gives us the “change in slope” in the post-WSM activity period. These two coefficients provide us with estimates of the magnitude of change and the rate of change over time in the outcome, respectively, resulting from the WSM activity.

The control variables in the regression model could include other environmental interventions that occur in the same area during the time period covered by the ITS analysis. For instance, we can control for the level of rainfall; patterns of land use and land coverage in the Shire River Basin that can affect soil erosion; floods or droughts that can impact soil erosion; seasonality in water flow; water turbidity, and so on. Controlling for such factors will help us reduce chances of estimating biased impacts and avoid drawing incorrect conclusions about the impact of the activity. For example, we would avoid concluding that the WSM activity had no effect when, in fact, the analysis failed to capture impacts because the evaluation occurred during a period of severe floods resulting in increased soil erosion and weed infestation. Similarly, we do not want to overstate the effect of the activity. This could happen, for example, if other projects that are operating in the same areas also affect weed infestation.

We will also estimate impacts separately by hydropower plant and for the barrage in Liwonde to examine whether the benefits of the activity varied by location. The equipment provided under the WSM activity would directly benefit the Nkula and Kapichira power plants; therefore we will assess impacts separately for those two plants. Moreover, because the Liwonde barrage is upstream of the Nkula power plant, more extensive harvesting of weeds, along with other improvements (from investments made by The World Bank), at the barrage may reduce weeds burdening the Nkula plant. Thus assessing the changes at the barrage will be important for the impact analysis. In addition, because the Tedzani power plant is located less than five miles downstream of the Nkula plant, it may indirectly benefit from the improved weed and sediment management at the Nkula plant. By analyzing data from the Tedzani plant, we might be able capture some of the spillover effects of the improvements at the Nkula plant.

## 2. Key outcomes for the impact evaluation

The WSM activity is expected to result in improved water storage at the hydropower plants, reduced amount of electricity not generated, and improved reliability of electricity. In Table V.1, we present a list of outcome domains for the impact analysis and recommended outcome measures within those domains.

**Table V.1. Outcome domains and measures for the WSM impact evaluation**

Domains	Measures
Effort to increase water storage capacity	Monthly amount of weeds harvested (metric tons); monthly volume of silt dredged (cubic meter); surface area of the head pond covered by weeds and sediment; monthly costs of weed management and sediment removal (adjusted for price inflation, in US\$); monthly weed management cost (adjusted for price inflation, in US\$); monthly cost of sediment removal (including staff, equipment and fuel; adjusted for price inflation, in US\$)
Power generation	Monthly power not produced by hydropower plant due to weeds and sedimentation faults (MWh); monthly power not produced by hydropower plant due to weeds (MWh); monthly power not produced by hydropower plant due to sedimentation faults (MWh); monthly hours of no generation due to weeds; monthly hours of no generation due to silt

The first and most basic question the impact analysis can answer is whether the WSM activity increased the efforts to improve the active water storage capacity at the hydropower plants. Increased efforts would be captured by calculating the monthly amounts of weeds



harvested and volume of silt dredged (and associated costs), as well as the surface area of the head pond covered by weeds and sediment. If the activity does not result in increased efforts captured by these measures, then it is unlikely that the WSM activity would have any effect on other outcomes related to generation and reliability of electricity. The impact evaluation of the WSM activity will involve additional outcome measures in the domain of power generation. In particular, we will analyze the impact of the activity on the monthly amount of power not produced due to weeds- and silt-related faults, as well as the hours when no power is generated due to weeds- and silt-related faults.

In analyzing these outcomes, we must be mindful of the statistical problem of multiple comparisons. This problem may arise when we estimate impacts on a large number of outcomes; a few of the estimates are likely to be statistically significant by chance, even if the true impact is zero. For example, if we were to analyze 20 independent outcomes on power generation at the 5 percent statistical significance, we would expect to find statistically significant impact estimates for one outcome simply by chance, even if the activity had no true impacts. To address the multiple comparisons problem, we will take a balanced approach that reduces the risk of false positives (finding statistically significant impacts by chance when true impacts are zero) while maintaining our ability to avoid false negatives. Before conducting the impact evaluation, we will work with MCC and MCA-Malawi to identify one or two primary outcome measures in each outcome domain discussed above. Primary outcomes will be the basis for tests of the main hypotheses in the impact analysis.

### **3. Pre-post design**

For some measures, there may be data limitations that would prevent us from establishing a time trend prior to activity implementation. In those cases, we will estimate activity effects by using a pre-post evaluation design, comparing changes for each outcome to a baseline measure prior to the intervention. To the extent feasible, we will control statistically for external factors that could influence WSM outcomes, such as rainfall. Although the pre-post design may not allow us to directly attribute changes in outcomes to the project activities, it could help generate suggestive evidence about the relationship of the project to observed outcomes.

### **4. Data sources**

The evaluation of the WSM activity will rely heavily on secondary data sources. For monthly data on the key outcomes discussed above, we will rely primarily on administrative records from EGENCO. For one specific outcome—the surface area of the head pond covered by weeds and sediment—we will rely on high resolution satellite image data that regularly capture images of the Shire River Basin. High spatial resolution mapping data captured by Earth-observing satellites can be used to classify the amount of head pond covered by weeds and sediment (Table IX.2 provides a description of satellite data sources). We will process this data to form a monthly time series that quantifies the total amount of head pond covered by weeds and sediment relative to the amount of head pond. Information on the timing of the use of WSM equipment is critical for the ITS design; for data on the timing of delivery, installation, and start of use of the equipment provided under the WSM activity, we will rely on updates from MCA-Malawi and the periodic progress reports EGENCO submits to MCA-Malawi.

We will rely on other secondary sources for data on factors that we would like to control for in the impact analysis. We expect to obtain monthly data on water turbidity from local water utilities (water boards); monthly precipitation, flooding, and drought information from the national meteorological services; and high resolution satellite image data for land use and land coverage in the Shire River Basin.

We will work closely with MCA-Malawi and rely on our local consultant to facilitate collection of the quantitative data required for the evaluation of the WSM activity. MCA-Malawi has been collecting data from EGENCO (and previously from ESCOM) and has shared the data collected to date with the evaluation team for the outcomes described in Table V.1. We will work with MCA-Malawi to receive periodic updates through the end of the compact. For the post-compact period, we will work directly with EGENCO to collect data for the remaining period. Our local consultant will work with MCA-Malawi and other entities such as the water boards and the Department of Water Resources to collect data on water turbidity.

Because the quantitative data required for the evaluation of the WSM activity will be derived from secondary sources, quality control is not an immediate concern. We will, of course, assess data quality by examining the data for missing rates and outliers. We will consider appropriate mitigation strategies depending on the extent of the issues; for example, we would consider multiple imputation for missing data and top or bottom coding for outliers, if such corrective measures are warranted.

## **B. Qualitative approach**

The quantitative impact evaluation of the WSM activity will be complemented by a qualitative performance evaluation addressing research questions 1, 4 and 5 (listed at the beginning of this chapter). In this section we describe the analytic approach, data sources, and our strategies for high quality data collection for the qualitative performance evaluation.

### **1. Analytic approach and data sources**

The performance evaluation of the WSM activity will consist of a qualitative implementation analysis as well as a qualitative assessment of maintenance and perceived sustainability of short-term outcomes achieved under the activity. The evaluation will rely on data collected from the relevant stakeholders. We will triangulate data from various sources by systematically categorizing and sorting the data to identify key themes and patterns in the responses while recognizing similarities and differences in perspectives.

Table V.2 presents a summary of data sources for the qualitative performance evaluation. These data sources include observations from site visits, administrative records, and in-depth interviews with staff at MCA-Malawi and EGENCO. The site visits will cover the three locations (the hydropower plants at Nkula and Kapichira, and the Liwonde barrage) where the WSM activity is being implemented. Opportunities to conduct site visits would occur naturally in the process of collecting data from key staff at each location, and the visits would allow the evaluation team to observe the use of the equipment provided under the activity. Administrative records will include implementation progress reports, monitoring data from the indicator tracking tables (ITT), the compact completion report that MCA-Malawi will prepare, and other relevant data. These documents would allow us to determine the extent to which the WSM activity met its

targets. Through in-depth interviews, we will collect data from program and monitoring and evaluation (M&E) staff at MCA-Malawi, as well as from EGENCO staff, both at the headquarters and the hydropower plants. Respondents for the in-depth interviews will be identified in collaboration with each organization so that we meet with the staff involved with implementation of the WSM activity. As indicated in Table V.2, we will interview one or two staff members (as a pair when possible) at each location, which should be sufficient to capture their perspective about implementation of the activity and utilization of the equipment.

**Table V.2. WSM qualitative performance evaluation: data sources**

Data source	Data collection method	Number	Sample
Site visits	Observations	3	Site visits to the Nkula and Kapichira hydropower plants and the Liwonde barrage
MCA-Malawi administrative data	Project implementation and monitoring documents	n.a.	Implementation progress reports, indicator tracking table (ITT), compact completion report from MCA-Malawi
MCA M&E staff	In-depth interviews	One	MCA-Malawi director of M&E
MCA sector staff	In-depth interviews	One to 2 staff	Senior sector staff in charge of the WSM activity such as the Environmental and Social Performance Director and the ENRM Manager
EGENCO headquarters staff	In-depth interviews	One to 2 staff	Senior staff in charge or working with MCA-Malawi
EGENCO hydropower plants and barrage staff	In-depth interviews	One to 2 staff at each location	Senior site manager and head engineer at each plant and the Liwonde barrage

## 2. Data collection timing, processing, and quality control

We will conduct two rounds of data collection for the qualitative performance evaluation of the WSM activity. The first round of qualitative data will be collected in mid-2018, prior to the end of the compact, to ensure availability of the MCA-Malawi and EGENCO staff members who are most knowledgeable about the activity implementation. We will also conduct site visits to the hydropower plants and obtain implementation reports and other administrative records during the first round of data collection. The second round of data collection, in mid-2020, will focus on maintenance and expectations about long-term sustainability of the outcomes of the WSM activity.

Mathematica will ensure high quality qualitative data by working with a local data collection partner while being in charge of protocol development and oversight on all aspects of the data collection process. We will develop tailored data collection protocols for each round of data collection. The protocols will cover similar themes across respondents to facilitate triangulation of responses. We will work with a local data collection firm and oversee all their efforts, from identifying and training enumerators to developing teams, conducting interviews, transcribing and translating, preliminary coding, and submitting data for analysis. Mathematica evaluation

team members will travel to Malawi for training, pre-testing or piloting of protocols, and the start of data collection for each data collection round. Mathematica and the local data collector will conduct some of the interviews jointly, particularly those that can be done in English, while the local data collector will conduct interviews in the local language and do translations. To ensure that protocols are properly followed, Mathematica will conduct interviewer observations and attend interviewer debriefings.

The local data collection partner will transcribe the interviews, translate in English when necessary, and transmit clean data to Mathematica. Interviews conducted in a local language will be transcribed directly in English, and verification of the transcription will be done by the respective interviewer to confirm the translation. Mathematica will provide templates to ensure uniformity across transcripts. We will review all transcripts for completeness and legibility and check that all interviews have been captured and coded correctly. Triangulation of data will begin as soon as practicable, and we will remain responsive to information learned in the conduct of the remaining interviews.

The local data collection partner is expected to be hired through a competitive process by Mathematica. The competitive procurement will help with identifying a high quality data collection firm while ensuring competitive costs. The selection of the firm will depend on cost as well as capabilities of the firms that respond to the call for proposals, including their experience, expertise, and capacity to meet the needs of our data collection effort. We have held initial meetings with a few prospective firms and have developed a list of qualified firms from whom we will solicit bids when procuring the data collection subcontract.

### 3. Analysis plan

We will use two principles to analyze qualitative data to address research questions 1, 4, and 5 for the WSM evaluation: thematic framing and data triangulation. These two principles will help us generate robust evidence of the implementation successes and challenges recognized by the stakeholders and will enable us to better understand the estimated impacts of the WSM activity on various outcomes.

**Thematic framing.** To better uncover patterns, themes, and issues in the qualitative data, we will develop a coding scheme with a hierarchy of conceptual categories and classifications linked to the research questions and the logic model. We will update this coding framework as we systematically review and assess our data according to the project's theory of change and program logic. Using NVivo software to assign codes to the qualitative data will enable us to quickly access data on a specific topic and organize information in various ways to identify themes and compile evidence supporting them. For instance, respondents may discuss the factors that supported or hindered the effectiveness of the WSM activity. Our coding structure will identify the common phrases and viewpoints. Conversely, respondents may disagree on resources available for maintenance or expectation about long-term sustainability of outcomes achieved under the WSM activity. Our coding structure will classify those divergent perspectives in a concrete manner. The software also facilitates subgroup analysis by allowing for categorization by geographic location or other salient respondent characteristics.

**Data triangulation.** Because the qualitative performance evaluation of the WSM activity will incorporate data from several sources, including staff at MCA-Malawi and EGENCO, as

well as administrative records and site visits, we will test for consistency and discrepancies in findings across these data sources by triangulation. This process facilitates confirmation of patterns or findings and identification of important discrepancies. A coding hierarchy will also enable us to integrate quantitative results, apply quantitative attributes to qualitative data, and support triangulation across data sources and types. For example, when investigating the benefits for power plants of dredging and weed harvesting, we will triangulate among quantitative data used in the impact analysis and data from the in-depth interviews with MCA-Malawi and EGENCO staff.

Mathematica will lead the conceptualization and implementation of the Nvivo coding of the qualitative data collected for the WSM evaluation. We will work with the local data collection partner to do the preliminary coding based on the question numbers in the protocols. We will then conduct in-depth coding and analysis to find emerging themes and develop a key set of qualitative findings that will take into account similarities as well as differences in perspectives across different respondents, providing a comprehensive picture of the implementation and outcomes. Depending on its capabilities, the local data collection firm may contribute to parts of the analysis.

The analysis of the qualitative data using the approach described above would allow us to generate themes and identify similarities and differences in perspectives regarding implementation, maintenance, and perceived sustainability of the outcomes of the WSM activity. The research questions to be addressed by the qualitative performance evaluation will provide the foundation for an organizing structure around the themes we will focus on. A brief discussion of these themes by research question follows.

We will address research question 1 (related to implementation analysis of the WSM activity) by assessing whether the WSM activity was implemented in compliance with the planned specification, schedule, and budget. This will allow us to examine the extent to which the activity was implemented in a cohesive way, whether implementation happened as planned, and whether implementation deviated from the initial plan and, if so, why. We will also assess key facilitators and barriers to successful implementation of the WSM activity. The assessment will focus on: (1) implementer capacity and coordination, (2) technical aspects of equipment use, and (3) other environmental or institutional factors that may have influenced the implementation of the activity. We will identify themes and triangulate information from the in-depth interviews with key stakeholders, as well as review the implementation documents and monitoring data to address these issues. We will collect information on whether the equipment was procured and delivered as planned; how the equipment is being used for dredging sediments and harvesting and hauling weeds; and whether there were any changes in the hydropower plant operational processes and activities, any equipment malfunctions, or other unforeseen constraints during implementation.

We will address research questions 4 and 5 (related to maintenance and perceptions of sustainability, respectively) using information from the second round of data collection. In addressing research question 4, we will assess personnel capacity and financial resources available at EGENCO and the hydropower plants to carry out necessary repair and maintenance activities to keep the equipment operational. For research question 5, we will assess stakeholder expectations about the sustainability of outcomes achieved through the WSM activity. We will

rely on stakeholders' responses regarding resources available for equipment maintenance and their expectations for the sustainability of outcomes achieved through the WSM activity. We will also use information from administrative records on maintenance and financial plans, and actual repair and maintenance efforts for the equipment provided under the activity. In addition, we will conduct site visits to the hydropower plants to speak with the staff about their on-the-ground experience and perceptions. These visits will also allow us to verify the status of the infrastructure and equipment through direct observation.

### **C. Evaluation risks and mitigation strategies**

We anticipate a few risks and challenges specific to the evaluation of the WSM activity. We discuss these risks here along with our proposed mitigation strategy. We will continue to update our risk assessments throughout the evaluation and adjust mitigation strategies as necessary.

**Lack of comparison group in the impact analysis.** The ITS design we plan to use to estimate the impact of the WSM activity does not involve a comparison group; consequently, we should be cautious about interpreting the findings. Because the WSM activity involves hydropower plants on the Shire River, it would not be credible to use another hydropower plant in Malawi as a comparison. For example, there is a hydropower plant on the Wovwe river in Karonga district in the Northern region; but considering its location, management, and much smaller size (with an installed capacity of 4.35 MW), it would not be a credible comparison for the hydropower plants that are benefitting from the WSM activity. Without a comparison group, we will not be able to rule out the possibility of bias in the estimated impacts. It is also possible that other underlying factors—such as variation over time in weed growth or sediment accumulation rate—which are correlated with the outcomes, will not be captured by our analysis. To lower the risks of bias, we will control for a range of related factors in the regression adjusted impact analysis under the ITS design (such as rainfall, land use and land coverage in the Shire River Basin that can affect soil erosion, floods or droughts that can impact soil erosion, seasonality in water flow, and water turbidity). In addition, considering the threats to internal validity, we will be very careful in interpreting the estimated impacts and will be transparent about the potential limitations when presenting the findings.

**ITS data limitations.** As previously discussed, we may not be able to obtain time series data for every outcome measure for use in an ITS analysis. For these outcomes, an ITS approach would not be an appropriate evaluation methodology; instead, we will employ a less rigorous pre-post analysis. To increase the likelihood of a successful ITS, we have already identified data sources for most outcomes measures and will continue to coordinate with MCA-Malawi to collect data for this analysis early in the evaluation.

## **VI. EVALUATION OF ENRM AND SGEF GRANT FACILITY**

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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. MCC and MCA-Malawi identified seven Upper Shire subcatchments and five Middle Shire subcatchments as priority target areas for grant programming. Out of 55 grant applications received, the grant facility awarded 11 three-year grants to nongovernment organizations. (Table II.2 in Chapter II summarizes the activities and intervention locations of all 11 grant projects.)

We plan to conduct a performance evaluation of the grant facility using qualitative and administrative data. A performance evaluation (as described in the previous chapter on the WSM evaluation) allows us to assess whether and the extent to which the grant facility produced its expected outputs and outcomes. The evaluation provides information on the structure and implementation of the grant facility and brings together the views of program stakeholders on how and why activity implementation and outcomes evolved as they did. Our evaluation will address the following research questions related to implementation of the grant facility and whether it achieved its objectives:

- 1) How was the grant facility activity implemented?
  - a) Was the grant facility implemented as planned? Why or why not?
  - b) Which implementation factors supported or hindered the effectiveness of the grant facility?
  - c) 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?
  - d) Was the 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?
  - 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?

### **A. Analytical method, sample, and data sources**

Our performance evaluation will assess grant facility implementation and objectives. To answer the first set of research questions, we will assess implementation fidelity, intervention prioritization, selection process, and grant oversight.

**Implementation fidelity.** To understand whether the grant facility was implemented as intended and which key factors affected activity implementation (research questions 1.a and 1.b), we will assess implementation fidelity as well as the barriers to and facilitators of successful implementation. To understand implementation fidelity, we will assess whether grant facility was implemented as planned, following the schedule determined at the planning stage while meeting the expected budget. If implementation differed from what was planned, we will also

look into why that was necessary, and how the changes affected overall implementation of the grant facility. We will conduct key informant interviews with grant facility staff as well as program staff from each grant program. These interviews will give us insights into the implementation process and any challenges in managing the grant facility, as well as reasons for deviations from a grant's original implementation plan. For grant program staff, we will be interviewing two managers who oversaw grant implementation and who also interacted regularly on the administrative side with the grant facility, including with financial and technical reporting. Our analysis will also be supported by administrative data collected from MCA-Malawi, including MCA-Malawi evaluations of the grants and the grant facility and quarterly monitoring data reported by each grantee.

**Intervention prioritization.** A key research question is to investigate whether the grant interventions funded aligned with the types of interventions that were recommended in the baseline environmental assessment (research question 1.c). LTS International et al. (2010) recommended that the following criteria be used to determine the appropriateness of a proposed intervention:

- Potential impact
- Reach to target population
- Acceptability to stakeholders
- Feasibility of implementation
- Feasibility of adoption
- Intervention sustainability
- Innovativeness
- Generalizability
- Staff/organizational capacity

LTS International et al. (2010) also recommended specific types of high impact ENRM and SGEF activities that should be funded (Table VI.1) and highlights a social and gender component that should be integrated into each ENRM activity. For instance, successful sustainable land management requires decision-making authority from women as well as leadership opportunities for women within the community.

Using the activities recommended in the baseline report, the call for proposals issued by the grant facility, and the reporting documentation from each grantee, we will develop a framework to evaluate whether the grant facility prioritized high impact activities within intervention categories that would have the greatest effect on improving sustainable land management given the recommended location for each activity. We will also assess whether social and gender considerations were integrated into ENRM activities. The framework will incorporate the criteria listed above for the recommended activity types, and we will assign points in each category based on our review of the 11 ENRM and SGEF grants.

In addition, the environmental baseline assessments detailed which types of activities should be implemented in specific areas within a subcatchment, such as steep slopes or near riverbanks. These were called "hot spots." Our evaluation of individual grants (Chapter VII) will validate whether recommended grant activities took place in identified hot-spot areas of the subcatchment. For the other grants that are not selected for evaluation, we will assess how well aligned their locations were with the hot-spot areas identified in the baseline assessments (to the extent we are able to obtain information about specific locations of their interventions from



grants monitoring reports). We will also develop a global information system (GIS) map of the Shire River Basin and overlay the hot-spot catchment areas, hydroelectric power plants, and, to the extent possible, locations of the grant activities on land coverage data. This visual representation will allow us to assess how grant activities line up with land coverage and identify the locations of the targeted catchment areas.

**Table VI.1. Recommended grant facility activities**

ENRM activities	SGEF activities
Sustainable land management	Promote new behavior patterns for men toward women
Increasing crop production	Provide functional literacy and numeracy training for female farmers
Sustainable charcoal production, forest management, and utilization	Conduct leadership training for women
Site-appropriate irrigation methods and water user cooperatives or associations	Promote economic empowerment for women through capacity building in business skills and marketing
Support to village savings and loans schemes (including micro- and small-business planning)	Organize participatory community engagement with men and women to discuss intra-household and community-level gender dynamics, cultural norms, women's rights, (particularly land rights), domestic violence, family planning, HIV/AIDS, delayed marriage for girls, and girls' education
Capacity building support to agriculture extension officers, local leadership, farmers, and small and medium enterprises	Support the development of VSLs
Nested integrated watershed management and land use planning (including in micro-watersheds, subwatersheds, and subbasins)	Conduct activities to enhance the adoption of sustainable land management practices such as tree planting, fuel-efficient cook stoves, and alternative income generating activities
Establish market information systems, such as through mobile phone networks	

Source: LTS International et al. 2014a and 2014c; input from MCC

**Selection process.** To evaluate the grant facility's selection process (research question 1.d), we will review MCA-Malawi's grant application scoring criteria, the scores given to each application, and the applications themselves (for both accepted and rejected grants). These documents will guide our analysis of whether the grant review process was structured with clear, fair, and transparent principles. We will compare MCA-Malawi's scoring criteria with activity priorities included in the baseline assessments. We will also rescore a random sample of accepted and rejected applications to test for inter-rater reliability, to see if our scoring results are aligned with MCA-Malawi when using the same scoring criteria. Generally, inter-rater agreement below 50 percent shows poor consistency in applying scoring standards and criteria (U.S. Department of Education 2014).

**Grant oversight.** Through interviews with grant facility staff at MCA-Malawi and program staff from each grant, we will assess the level and quality of grant oversight (research question 1.e). We will develop criteria for scoring grant oversight, such as the number of contacts between MCA-Malawi and grantees (email, phone, and in person); reporting schedule and standards

(financial and technical); and consequences of violating reporting requirements or for submitting deliverables that did not meet MCA-Malawi's quality requirements, as well as how those consequences were carried out. We will combine the scoring on grant oversight with qualitative information from MCA-Malawi grant facility staff as well as MCC resident country mission staff about the factors that may help explain the varying needs and levels of oversight across grants as well as perceptions from grantees about the quality and frequency of grant oversight.

**Grant facility rationale.** We will review the decision-making process to establish a grant facility to assess if the process was based on rigorous economic and programmatic evidence and a careful weighing of alternative arrangements to support ENRM and SGEF activities. We will examine programmatic documents and conduct interviews with relevant MCA-Malawi and MCC staff that oversaw the establishment and management of the grant facility. We will also assess the costs associated with managing a grant facility by reviewing MCA financial statements. Such an analysis will inform MCC on whether a grant facility type arrangement is an efficient way of implementing project activities.

To answer our second research question, we will first examine if the objectives listed in the grant facility manual fully capture the recommendations described in the Upper and Middle Shire baseline reports or if there were certain activity types or locations that were not reflected in the grant facility manual. This will help us process trace between initial recommendations and ultimate grant facility outcomes to identify which parts of the activity were contributing to or hindering the achievement of outcomes. We will then conduct a qualitative performance evaluation of whether the grant facility met its objectives based on criteria described in the grant facility manual. These objectives include the following:

- Maintain ecological integrity of landscapes.
- Reduce soil erosion that contributes to sedimentation and aquatic weed infestation.
- Allow beneficiaries to innovate and implement technologies that have proved to reduce soil erosion.
- Improve control and sustainable management of resources by women and vulnerable groups (decision-making power).
- Support organizations to initiate or expand their efforts in addressing the environmental and natural resources management challenges.
- Address the social and gender disparities in the Shire River Basin.
- Improve participation of both men and women in the implementation of ENRM activities.

The qualitative analysis will be based on interviews with grant facility staff and grant program staff as well as grant quarterly and final reports, MCA-Malawi internal evaluations, and grant monitoring data collected by MCA-Malawi. We will develop criteria to assess each objective of the grant facility, including by using the indicator tracking table that MCA-Malawi created to collate monitoring data from each grantee. Indicators will be aligned to the relevant grant facility objective. For example, the indicator on the number of women who were provided with leadership training will be used in assessing the extent that the grant facility improved control and sustainable management of resources by women and vulnerable groups. The

indicator on planted trees that survived will help assess whether the grant facility met its objective to reduce soil erosion. The full list of MCA-Malawi monitoring indicators is in Appendix Table A.1. For qualitative interviews, we will consolidate stakeholders' perceptions by using thematic framing to identify commonalities and differences among grant program staff and grant facility staff. This data will be particularly useful in examining whether the grant facility supported organizations in expanding their ENRM efforts.

In addition, we will analyse the funding amount each grant allocated to each of its activities and the total resources devoted to each activity type – such as tree planting, supporting VSLs, or trainings on conservation agriculture – across all 11 grants, if grants can provide a detailed budget breakdown by activity. This will help us identify whether achieving grant facility objectives was related to the amount of resources devoted to particular activity categories.

Although in this evaluation we will not be able to measure soil erosion effects or quantify changes in social and gender disparities attributable to the grant facility, we will provide project learning on factors that may be driving the collective effectiveness of using a grant facility to address these objectives. We will also be able to assess which specific challenges may be impeding the grant facility from achieving its objectives. To the extent we can evaluate (through the grant case studies described in Chapter VII) that the grant facility outcomes have been achieved by the individual grants, we will assess how the grant facility supported and managed the grants to facilitate the achievement of these outcomes.

## **B. Data collection timing, processing, and quality control**

We will conduct one round of data collection to evaluate the grant facility. Our key informant interviews with grant facility staff at MCA-Malawi and grant program staff will occur in mid-2018, prior to the close of the compact, to ensure the availability of respondents. We will develop tailored interview protocols that cover similar topics across respondents to facilitate comparisons between grant programs. The evaluation team members will travel to Malawi for piloting protocols and the start of data collection. We will collect administrative data on the grant facility throughout the evaluation, through the close of the compact. We will coordinate closely with MCA-Malawi to obtain necessary documents and other administrative data, including grant applications and how they were scored. We will implement strict data security protocols to ensure that sensitive information from grant applications is kept confidential and reviewed by project team members only. We will re-score a random sample of grant proposals at our offices in the United States. Our procedures for quality control and processing qualitative and administrative data will follow the procedures described for the evaluation of the WSM activity (Chapter V).

## **C. Analysis plan**

Our analysis of qualitative and administrative data will follow methods discussed in previous chapters, including thematic framing using NVivo and data triangulation across multiple data sources and types. This will enable us to develop a key set of qualitative findings that will take into account similarities and differences in perspectives across respondents, providing a comprehensive picture of the implementation (research question 1) and outcomes (research question 2) for the grant facility. Through thematic framing we will categorize responses from each grant program to identify common or divergent responses for activity

implementation and grant oversight, allowing us to compare and contrast among the grants. This will be particularly important in classifying whether key implementation factors were related to the design of the activity, the implementation process by the grant facility or the grantees, or the environment outside of the scope of the activity.

Through data triangulation, we will cross-reference data from interviews, grants reports, and the grantee indicator tracking table to test for consistencies and discrepancies across data sources when assessing whether the grant facility achieved its objectives as listed in the grant facility manual. Defining and measuring grant facility objectives will include both quantitative data (from aggregating MCA-Malawi monitoring indicators related to each objective) and qualitative data (from coding the perceptions of grant facility and grant program staff on activity achievements and challenges).

This evaluation will also use criteria established at baseline for appropriate types and locations of grant activities, as well as scoring criteria for grant applications. Our analysis will use these criteria to assess whether the grant facility achieved its aims.

#### **D. Evaluation risks and mitigation strategies**

Our performance evaluation of the grant facility is subject to a few risks and challenges. We present here evaluation risks we have identified that are specific to this activity, along with our proposed mitigation strategies. We will continue to update our risk assessments throughout the evaluation and adjust mitigation strategies as necessary.

**Lack of quantitative analysis.** Although some grant facility objectives include questions aligned with quantitative measurement (such as reducing soil erosion), our evaluation design will only be able to answer these questions qualitatively, primarily relying on self-reported data from grantees and key informant interviews with staff from the grant programs and the grant facility. We will employ a rigorous qualitative approach, though we will not be able to provide quantitative judgment on the changes in catchment areas caused collectively by the grant facility.

**Rescoring grant applications.** Properly scoring grant applications can be a costly and timely process to ensure that coders are in agreement about scoring procedures and are carefully reviewing the grant applications. We will use experienced qualitative coders and pilot the scoring protocol to estimate time, cost, and accuracy of the recoding to ensure that we complete this task cost effectively. This analysis is also dependent on MCA-Malawi's sharing of applicant scores and its scoring criteria. We have had preliminary discussions with MCA-Malawi staff about this possibility, and they indicated that they would be able to share these materials.

## **VII. EVALUATION OF ENRM AND SGEF GRANTS**

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Through the ENRM and SGEF grant facility, MCA-Malawi provided grants to 11 organizations to be implemented over a three-year period. These grants sought to improve sustainable land management and address social and gender barriers that limit the full participation of women in household and community decision making, particularly in relation to natural-resource-based economic activity (MCA-Malawi 2014b). The ultimate goal of grant facility grants is to improve the efficiency of hydropower production. There were 12 eligible catchment areas in the Shire River Basin where grantees could propose to conduct programming.

We will evaluate five of the grants using a case study approach that incorporates primary qualitative as well as programmatic data collected by the implementers. A case study allows for an in-depth examination of each grant's implementation, ENRM and SGEF outcomes, and prospects for sustainability. From this, by conducting a cross-case comparative analysis, we can draw broader conclusions about which types of activities and training approaches are most effective. The cross-case analysis compares outcomes across the five grant case studies and can illustrate common themes and lessons that emerged, thus identifying effective or deficient activity intervention approaches. Evidence from the case studies can help inform the types of activities that the Environmental Trust chooses to fund after the compact ends. We will answer four types of research questions when evaluating each of the five grants: (1) implementation questions that examine program fidelity and program logic; (2) ENRM research questions that examine land management practices; (3) SGEF research questions that assess behavioral and attitudinal changes related to the role of women in the community; and (4) a sustainability-related research question that focuses on whether program outcomes will be maintained or expanded after the grants end.

### *Implementation*

- 1) Which intervention was implemented and what was the program logic underlying it?
- 2) How was the program implemented?
  - a) How did implementation change from what was planned, and why?
  - b) Which implementation factors supported or hindered the completion of the intervention?

### *ENRM activities*

- 3) To what extent did the intervention lead to adoption of conservation agriculture and land management practices by farmers and communities?
  - a) Which land management practices are more readily adopted by farmers and communities, and why? Are there differences in adoption between male and female farmers?
  - b) Is it possible to differentiate between effective training approaches and practices that farmers are predisposed to adopt? If yes, are certain training methods associated with greater farmer adoption? Are different training methods associated with better results for male and female farmers?
  - c) What was the relationship, if any, between ease of adoption, farmers' perceptions of effectiveness, and farmers' tendency to adopt different practices?

*SGEF activities*

- 4) To what extent did the intervention affect gender roles in the household and communities?
  - a) To what extent did the intervention lead to greater joint household decision making regarding land and natural resource management and household finances?
  - b) To what extent did the intervention lead to changes in division of labor on the farm and at home?
  - c) To what extent did the intervention lead to leadership opportunities for women? To what extent did the intervention promote female-headed household involvement in community decision-making?
- 5) Were grants that focused more on ENRM or SGEF activities more or less effective than grants that targeted both types of activities?

*Sustainability*

- 6) What are stakeholders' perceptions of the sustainability of grant activities to improve sustainable land management and address social and gender barriers? What factors were driving beneficiaries to continue to adopt SLM practices?

**A. Selection process and overview of grants**

We followed a careful process to select 5 of the 11 grants to evaluate using the case study approach to maximize program learning. We relied on information gathered from interviews with MCA-Malawi grant facility staff, program staff from 10 of the 11 grants, site visits to three grant intervention areas, and a document review of grant proposals and quarterly reports. Using this information, we developed selection criteria to determine our grant evaluation recommendations. The selection criteria included the following:

1. **Strength of program implementation.** Through the evaluation, we intend to identify which program approaches are successful regardless of the implementer. To that end, we focus on what stakeholders perceived as well-implemented programs that were funded for the full three years of the activity.
2. **Geographical dispersion.** The Upper and Middle Shire River Basins encompass several ecological zones with different topographical features. We chose grants that collectively provide learning for a wide area of the Shire River Basin and cover several agro-ecological zones, including hot-spot areas (such as steep slopes) identified in the environmental baseline assessments.
3. **ENRM and SGEF activities.** Some grantees focus on the ENRM objectives of the grant facility; others concentrate on achieving SGEF objectives as defined in the ENRM and SGEF grant manual. The selected grants will collectively cover both sets of objectives.
4. **Distinct approaches.** Many grantees conduct similar activities, which tend to be a standard set of conservation agriculture and female empowerment programs. A few grantees, however, conduct more novel conservation agriculture interventions. In addition to evaluating traditional programs, we will evaluate innovative conservation agriculture approaches that have the potential to provide evidence on program effectiveness of both new and traditional practices and methods.

5. **Strong program presence.** To assess community-level outcomes, such as adopting conservation agriculture techniques, our evaluation will focus on grantees with a larger program presence in the catchment area compared to other grantees. We are avoiding grantees whose programming overlaps with other organizations in the same area, which would make it more difficult to identify the results of each grantee's program

After discussions with MCC and MCA-Malawi, we identified the following grants that met the selection criteria for our evaluation (Table VII.1).

**Table VII.1. ENRM and SGEF grants to evaluate**

Grants	Well-implemented	Middle Shire	Upper Shire	ENRM focus	SGEF focus	Distinct approach	Strong program presence
Catholic Commission for Justice and Peace (CCJP)	X		X		X		X
Foundation for Irrigation and Sustainable Development (FISD)	X	X		X		X	X
Training Support for Partners (TSP)	X	X		X		X	X
United Purpose (UP)	X		X	X			X
Women's Legal Resources Centre (WOLREC)	X	X	X		X		X

These five grants encompass a variety of activities, some that are unique to a particular grant and others that overlap with multiple grants. FISD is constructing a 60-hectare irrigation scheme to support winter cropping and sustainable water use management. TSP works through village clan systems as a way to encourage sustainable land management. WOLREC and CCJP focus their activities on achieving the SGEF objectives. UP conducts traditional conservation agriculture programming, which is also being implemented by several other grantees. Table VII.2 summarizes the activities each grantee is conducting. (Table II.2, in Chapter II, summarizes the activities and intervention locations of all 11 grantees.)

**Table VII.2. Proposed activities by grants being evaluated**

Activity	CCJP	FISD	TSP	UP	WOLREC
Adult literacy training	X	X	X	X	X
Business/marketing training	X	X	X	X	X
Conservation agriculture	X		X	X	
Development of irrigation scheme		X			X
Establish village savings and loan groups	X	X	X	X	X
Fruit tree seedlings	X	X	X	X	
Fuel-efficient cookstoves	X			X	
Gender equality trainings with men	X	X		X	X
Household decision making/budgeting	X				
Lead farmer trainings	X	X	X	X	
Leadership workshops, including with women	X	X	X	X	X
Livestock production	X	X			
REFLECT Circles	X	X	X	X	X
Ridge construction			X	X	
Strengthen government structures/community mobilization	X	X	X	X	X
Tree/grass planting	X	X	X	X	X

Source: Grant proposals, April–June 2016 grant quarterly reports, January–March 2017 quarterly reports, discussions with MCA-Malawi.

Note: The final activities implemented could differ because some areas were not contracted or the location of implementation changed. While the types of activities are similar across grantees, the resource allocation for each activity type may vary.

## **B. Analytical method, sampling, and data sources**

We will use a case study approach to evaluate each grant program, conducting a deep-dive analysis to understand program implementation, how the program affected beneficiaries, and which outputs and outcomes have been realized by the activities. This process will provide rich contextual information for understanding results and outcomes. Because each grant is treated as a case and is studied holistically, we will have a detailed understanding of the mechanisms behind apparent associations of different activities with outcomes of interest. Looking at all five cases and comparing the results could lead to a richer understanding of how common or different activities are associated with outcomes of interest. We will also examine whether benefits of each program were sustained after the program ended. Since many of the activities that grantees are implementing have been rigorously evaluated in similar settings, we will compare our case study findings to relevant literature about conservation agriculture and women’s empowerment interventions in southern Africa, as highlighted in the literature review in Chapter III.

Our case studies will draw on an array of qualitative data sources to answer our research questions.

We will conduct focus group discussions with beneficiaries and key informant interviews with select beneficiaries, community leaders, the grants’ program staff, and program collaborators from government agencies such as the Community Development Department, the



Social Welfare Department, the Ministry of Agriculture, and the Village Natural Resources Management Committees. Key informant interviews facilitate discussions around sensitive topics that people may not be comfortable discussing in a group, such as their organization's performance or perceptions of working with MCA-Malawi and leaders within their targeted community. Key informant interviews also provide a format for in-depth discussions on detailed program elements and processes. We will also directly observe program sites and analyze administrative data from MCA-Malawi and each implementing partner.

Focus groups with ENRM beneficiaries will allow us to understand how and why farmers do or do not adopt specific conservation agriculture practices. Focus groups are most useful to spur discussions among respondents, creating an atmosphere in which ideas can build upon one another and providing opportunities for consensus or disagreement in a group setting. Focus groups also allow us to collect opinions from multiple stakeholders at the same time, increasing efficiency. During the second round of data collection in 2020, we will also include indirect beneficiaries in the focus groups. These are farmers who did not directly participate in grant activities but may have benefited due to their proximity to direct beneficiaries. By including these farmers, we will assess whether conservation agriculture practices spread within the community and the key mechanisms driving adoption.

To understand how SGEF activities have affected household decision making and the role of women in the community, we will conduct in-depth, one-on-one interviews with women who actively participated in the SGEF activities. Individual interviews will allow women to express themselves in a secure space (because women's empowerment could be a sensitive topic of discussion). We will also conduct focus groups both disaggregated by gender and combined to gather insights into how both men and women participated and were affected by these activities, including their perceptions of the training methods and whether outcomes are being sustained over time. Finally, we will observe community meetings, such as village development committees, area development committees, or natural resource management committees, to assess the level of female leadership and participation in community decision making. Table VII.3 summarizes the data sources and sample for conducting the case studies.

**Table VII.3. Qualitative data sources for grant case studies**

Data source	Data collection method	Number	Sample
Grants' program staff	Key informant interview	2 to 3 staff from each grant	Program staff that implemented activities, including at least one member of senior management who directed the program and one staff member who oversaw SGEF activities
MCA-Malawi grants oversight staff	Key informant interview	3	MCA-Malawi staff who oversaw the SGEF and ENRM grants and can provide insights into grant performance, including at least one member of the Social and Gender Directorate
Community leaders	Key informant interview	4 to 5 for each grant	Leaders of the community who interacted with grant program staff to coordinate and shape activities, including women leaders
SGEF beneficiaries and ENRM beneficiaries (women and men)	Focus group discussions (gender disaggregated and mixed)	5 to 7 for each grant	Active participants in SGEF activities such as REFLECT Circles, VSLs, and leadership trainings Active participants in sustainable land management activities including tree planting, ridge construction, and lead farmer trainings
Women beneficiaries and spouses	In-depth one-on-one interviews	5 to 7 for each grant	Active female participants in SGEF activities and their spouses (interviewed separately), including community leaders, widows, female heads of households, and young and elderly women
Relevant government employees	Key informant interview	3 to 5 for each grant	Staff from government agencies that supported grant programming such as the Community Development Department, the Social Welfare Department, the Ministry of Agriculture, and the Village Natural Resources Management Committees
Community meetings	Direct observation	3 to 4 for each grant	Meetings of area or village development committees, or village natural resource management committees, that were supported by the grant program
Grant progress reports and MCA-Malawi monitoring data	Document review	All available documents	Self-reported data from grantees on a common set of indicators as well as narrative reports from both the grantees and MCA-Malawi

The number of proposed focus groups or interviews is based on receiving sufficient information to answer our research questions. For example, interviews with two or three grant staff per grant can provide enough information to allow us to fully understand a program's technical, administrative, and financial components. Similarly, interviews with four to five community leaders per grant will allow us to assess how the grant program operated and was received across the communities it served. The exact number of beneficiary interviews will depend on the geographic and activity scope of each grant.

### **C. Data collection timing, processing, and quality control**

We will conduct two rounds of qualitative data collection. The first round will occur in mid-2018, prior to the end of each grant, and will be used to evaluate implementation and short-term outcomes of the grant activities. This will also enable us to work with the implementing organization to accurately identify the survey sample and the intervention area prior to the end of the grant. The exact timing of the data collection will depend on the most appropriate time in the agriculture season to measure outcomes for each grant activity and on the availability of survey participants. The second round of the survey will occur two years later, in mid-2020, and will focus on evaluating how outcomes have been sustained over time. Given the extent of qualitative data collection in 2018, we anticipate needing to collect data on a smaller number of respondents in 2020 to answer the evaluation questions. We will follow the same data processing and quality control measures as described in Chapter V.

### **D. Analysis plan**

We will use a variety of methods to analyze quantitative and qualitative data for the case studies to address our research questions. Below we discuss how we will apply these methods to different research questions.

**Grant implementation (research questions 1 and 2).** To understand and characterize each grant's program logic and design, we will review grant program documents and interview grant program staff to identify (1) program objectives and activities; (2) the target population, including direct and indirect beneficiaries; (3) key activity stakeholders and partners; and (4) activity funding and implementation timeline. We will use this information to develop logic models of each grant program as intended and use these models to assess whether each grant program had a robust set of activities to achieve its objectives.

To evaluate the quality of program implementation for each grant, we will institute an **implementation effectiveness framework** that classifies implementation facilitators and barriers into three categories: (1) intervention design characteristics, including the program logic for each grant; (2) implementation process characteristics, such as the strengths and weaknesses of the trainers for grant activities, grant organization relationships with the community, how activity timing coincided with the agriculture calendar, as well as any program administration and management issues; and (3) environmental factors exogenous to the intervention, including the rainy season weather patterns, political climate and electoral events, and similar interventions being conducted by other groups in the same area.

By classifying these factors, we will be able to identify grants or activities that are experiencing similar factors that affect implementation effectiveness. We can then more effectively compare outcomes across grants, such as the take-up rate of SLM practices following trainings, the utilization of fuel-efficient cookstoves, and female participation in VSLs and on community development councils. We will be able to explain differences in outcomes based on implementation factors unique to each grant. We will also employ data triangulation to cross-check results between interviews with grants program staff and beneficiaries, MCA-Malawi monitoring data, direct observation, and primary survey data.

**ENRM and SGEF activities (research questions 3, 4, and 5).** To assess adoption of land management practices and changes in gender roles in the communities, we will conduct thematic framing of qualitative data and triangulate findings between multiple data sources. **Thematic framing** will help us identify common and conflicting viewpoints across interviews. For instance, respondents may discuss the allocation of household labor or the advantages of certain farmer training approaches using similar underlying themes. Conversely, men and women may disagree on how they view results from REFLECT Circles or the division of responsibilities within the household. We will classify those divergent perspectives in a concrete manner. We will employ **data triangulation** to test for consistency and discrepancies in findings across multiple data sources. For example, when investigating adoption of conservation agriculture practices, we will triangulate among focus group discussions with activity beneficiaries, MCA-Malawi monitoring data and grant self-reports, and key informant interviews with grant program officers and community leaders.

By analyzing qualitative data, we will be able to understand *why* certain farming practices are adopted and spreading or not adopted at all. We will also be able to assess the environmental, programmatic, cultural, or other factors and conditions that supported or hindered farmers from adopting these practices. Our qualitative analysis will cover such grant outcomes as planting trees, using fuel efficient cookstoves, actively participating in VSL organizations, implementing conservation agriculture techniques, charcoal production (an undesirable outcome), the extent of women in community leadership positions, perceptions of labor allocation within the household on and off the farm, and perceptions of women's decision-making authority within the household and their role in the community. By conducting two rounds of qualitative data collection, we will be able to examine how grant outcomes change over time, including perceptions of the role of women in the community and whether farmers are continuing to implement conservation agriculture practices.

Each case study will be analyzed individually to examine how each grant achieved program outcomes; additionally, we will conduct a **cross-case comparative analysis** to compare and contrast results from each case study for broader learning on training techniques and activity structure. This analysis will allow us to identify whether there are advantages to integrating SGEF activities into the broader ENRM approach or if it is more effective for an organization to focus on implementing one set of activities (question 5). Similarly, we can learn how the scale or scope of activities relates to effectiveness. For instance, if a larger, more comprehensive tree-planting activity is more effective and sustainable than a smaller, targeted one. We will also examine whether common issues are driving or hindering program sustainability, such as poverty and population density. Finally, this analysis will include an examination of how and where the projects were implemented and how they compare with the target area and intervention recommendations from the baseline environmental assessments. This will shed light on whether projects adopted recommendations from the baseline assessments in implementing the ENRM and SGEF activities and whether those activities have been carried out in the specific recommended locations, such as steep slopes or near riverbanks.

To conduct this analysis, we will draw on results from the implementation effectiveness framework described to answer research questions 1 and 2. By comparing implementation factors across grants, we will be able to identify grants or activities that are experiencing similar factors that support or hinder activity implementation.

**Grant sustainability (research question 6).** To evaluate the sustainability of grant activities, we will code responses from interviews with ENRM and SGEF beneficiaries using thematic framing. We will examine beneficiary perceptions on how well SLM practices and any behavior changes associated with the SGEF activities will be maintained and will spread in their communities after the grants end. We will compare results from data collected in 2018, near the end of the compact, with data collected two years later, in 2020.

### **E. Evaluation risks and mitigation strategies**

We anticipate a few risks and challenges specific to the case study evaluation of the ENRM and SGEF grants. We discuss these evaluation risks here along with our proposed mitigation strategies. We will continue to update our risk assessments throughout the evaluation and adjust mitigation strategies as necessary.

**Interpretation of results.** A case study approach by design relegates the findings to the specific grants in the specific context in which they were implemented. Also, this design does not include a comparison group, so we cannot estimate what would have happened in the absence of the intervention; that is, we cannot attribute outcomes solely to the intervention. However, a case study approach provides informative and valuable program learning. Although we cannot causally attribute results to the intervention, we can understand *how* certain outcomes were achieved through rigorous qualitative research.

We can also draw broader lessons through comparative analysis of the five grants and by comparing our case study results to rigorous studies of similar interventions in southern Africa. However, conducting comparisons of case studies has its risks. Even if multiple grants are implementing some of the same activities, the activity approaches and intervention contexts may be different enough that it would be difficult to compare outcomes and draw out program learning. We will assess grants on similar metrics when possible and carefully note the caveats in any cross-case comparisons.

**Cooperation from implementing organizations.** In order to clearly identify activity beneficiaries and understand the specific location of each activity, we will need cooperation from each grantee to explain where they worked and whom they worked with. To facilitate this cooperation, we were formally introduced by MCA-Malawi staff to 10 of the 11 grantees during our assessment trip and discussed with them how we could be a valuable learning partner to provide feedback on their program's approach, implementation, and achievements. Further, we will hold our first round of data collection prior to the end of the grant period so that the implementing organizations are still active in the intervention areas and available to assist us.

**Lack of quantitative data.** Even though in developing the evaluation design for the ENRM and SGEF grants we considered conducting a household survey for each grant, given limited resources available to the evaluation and MCC guidance, conducting the surveys were deemed infeasible. Absent quantitative data, the evaluation will not be able to directly measure adoption rates of conservation agriculture and sustainable land management practices, or women's empowerment situation across communities served by the grants. We will also not be able to compare changes in the related outcomes over time. Despite the lack of quantitative data, the evaluation will address the research questions identified for the grant case studies using qualitative data. Although without the surveys we will not be able to produce broad-based

measures of some of the outcomes, the rich qualitative data we plan to collect will enable us to understand the underlying conditions and mechanisms related to the adoption of various farming practices and shifts in women's empowerment in the household and in the community.

## **VIII. EVALUATION OF THE ENVIRONMENTAL TRUST**

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MCC is establishing an environmental trust to create a sustainable funding mechanism for continued support of the ENRM and SGEF activities after the end of the compact. MCC contracted with a consortium of organizations to set up the trust: Mulanje Mountain Conservation Trust (MMCT), Malawi Environmental Endowment Trust (MEET), Wildlife Conservation Society (WCS), and International Union for Conservation in Nature (IUCN). The trust-establishment consortium began in January 2016, and MCC is laying the administrative and operational groundwork to have a functioning trust in place by the end of the compact in September 2018.

We propose to conduct a performance evaluation of the trust activity to assess implementation and sustainability. Our evaluation will address the following research questions using administrative and qualitative data:

- 1) Which implementation factors supported or hindered the 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 fundraising strategy for achieving sustainable financing over the long term? How was it developed?
- 3) How did leaders of the implementing consortium use their organizations’ experiences to establish the trust?
  - a) What lessons did these leaders draw from their own grant-making experience that they applied to the establishment of the trust?

### **A. Analytical method and data sources**

A performance evaluation, as described in previous design chapters, would enable us to assess whether, and the extent to which, the trust produced its expected outputs and outcomes. It will provide information on the structure and implementation of the trust activity and allow us to document the views of beneficiaries and program implementers on activity implementation and outcomes. We will draw on both qualitative interviews (conducted once with each stakeholder in either 2018 or 2020) and administrative data to answer the research questions mentioned above. Table VIII.1 summarizes our data sources for this performance evaluation.

The number of proposed key informant interviews is based on receiving sufficient information to answer our research questions. For instance, we believe interviewing two or three trust board members and steering committee members will provide us with sufficient information to understand the operational workings of those entities and the interviewees’ perceptions of the establishment of the trust.

**Table VIII.1. Environmental Trust evaluation data sources**

Data source	Data collection method	Number	Sample
Implementing consortium staff members	Key informant interviews	One or 2 from each organization in the consortium	Senior managers and program staff directly involved in establishing the trust
Trust steering committee	Key informant interviews	2 or 3	Male and female active committee members, including the committee president
Trust board of directors and staff	Key informant interviews	3 or 4	Male and female board leadership team members and trust staff, including the president, treasurer, and executive director
MCA-Malawi staff	Key informant interviews	2	MCA-Malawi staff who oversaw the trust consortium contract
Trust administrative data	Document review	All available documents	Trust charter, strategic plan, budgetary projections, and financial documents
MCA-Malawi administrative data	Document review	All available documents	Documents presenting the organizational structure and operating procedures for the establishment of the trust
New grantees	Key informant interviews and document review	To be determined	Interviews with senior management staff among grantees and review of their grant proposals (if the trust has funded grants by 2020)

We will answer the first two research questions through key informant interviews with members of the trust steering committee and board of directors, MCA-Malawi staff who oversaw the trust consortium contract, and key program staff implementers from MMCT, MEET, WCS, and IUCN. These interviews will allow us to understand the successes and challenges in establishing the trust, as well as the extent to which it is operational, has established clear policies and procedures, and has secured sustainable funding sources through a Payment for Ecosystems Services or other mechanisms. We will also be able to document the continuation of grant investments (actual or planned). Depending on the extent of the trust's functionality, we may be able to conduct additional interviews with new grantees. To assess operational and financial functionality and sustainability, we will review administrative data such as the trust's charter, strategic plan, and budgetary projections and financial documents.

To answer our third research question, we will interview senior managers and program staff from the implementing consortium to document similarities and contrasts between the trust and the partner organizations and to learn which lessons they applied from their own organizational experience when establishing the trust. For example, we will speak with the leadership team at MEET, which has been providing grants to community-based organizations in Malawi for 16 years, to understand their grant administration practices. We will ask MEET to discuss specific grant-making lessons and how they used the knowledge gained to set up the Environmental Trust. This may allow us to identify best practices in grant making that could inform sustained operations of the Environmental Trust established under the compact. We may also find that the operational procedures vary substantially between grant-making organizations based on the types



of organizations they work with and the size of the grants. We will use these lessons to put into context the trust's administrative and financial protocols and processes.

### **B. Data collection timing, processing, and quality control**

We will conduct two rounds of data collection for the evaluation of the Environmental Trust. In mid-2018, near the close of the compact, we will interview activity implementers and trust steering committee members to assess progress toward establishing the trust. We will conduct a second round of qualitative interviews in mid-2020 with trust board members to evaluate the operationalization of the trust post-compact. As noted for the WSM activity evaluation in Chapter V, Mathematica will be responsible for obtaining administrative data and will collaborate with an in-country data collection partner to collect qualitative data. Our procedures for quality control and processing qualitative and administrative data will follow the protocols described for our WSM evaluation.

### **C. Analysis plan**

Our analysis of qualitative and administrative data will follow methods discussed in previous chapters, including thematic framing using NVivo and data triangulation across multiple data sources. Thematic framing will allow us to code responses on grant-making best practices from the implementing consortium to identify common themes and recommendations and consolidate stakeholders' perceptions (research question 3). Data triangulation will improve our understanding of activity implementation by cross-referencing administrative data with interviews of implementers, board members, and members of the steering committee (research question 1). Any divergences in viewpoints will be captured and highlighted in our coding framework.

To assess activity implementation, we will follow the same framework for implementation effectiveness as described in the analysis plan for the grant case studies (Chapter VII, Section D), including identifying key implementation themes and the factors, incentives, or circumstances that complicate or enhance implementation. For instance, the conceptual structure of the trust would be an intervention design characteristic; the strengths and weaknesses of the trust establishment consortium would be classified as implementation process characteristics; and the economic climate affecting corporate water users and smallholder farmers would be an exogenous environmental factor.

Our performance evaluation will also use the Trust Feasibility Study (Spergel 2015) as a framework to benchmark progress on meeting trust goals and objectives (research question 2). The study lays out clear outputs for establishing the trust, including necessary operational, financial, and administrative conditions. The study also lists key steps for the steering committee and the board of directors, such as the following:

- Securing an endowment that meets minimum requirements
- Conducting a stakeholder workshop to discuss and validate the trust deed
- Legally registering the trust entity and hiring key personnel, including an executive director
- Finalizing trust investment guidelines and an operations manual

Through stakeholder interviews and a thorough review of trust documents, we will assess the extent to which each step was or was not achieved, the time frame for completion of each step, and whether there were any resource constraints or coordination challenges in completing each step. There may be legitimate reasons for implementation deviations from the Trust Feasibility Study, as plans for the trust and political conditions evolved. We will examine why there were deviations, if any, and what effects those deviations had on the objectives of the trust. We will evaluate progress in establishing and operationalizing the trust in 2018, as an interim assessment, and again in 2020, as part of our final evaluation.

#### **D. Evaluation risks and mitigation strategies**

Our performance evaluation of the Environmental Trust is subject to several risks and challenges. We present here evaluation risks we have identified that are specific to this activity, along with our proposed mitigation strategies. We will continue to update our risk assessments throughout the evaluation and adjust mitigation strategies as necessary.

**Establishment of the trust.** Although the implementing consortium has taken steps to create the trust, it is possible that it will not be fully operational at the time of data collection in mid-2018. There is also a risk that the trust will not have secured a sustainable long-term funding source. Such delays in the establishment of the trust would delay our data collection or limit learning from the interim evaluation. We will coordinate closely with MCA-Malawi to track progress on the establishment of the trust and adjust our data collection schedule and analysis plan as needed and allowable by our budget.

**Cooperation from implementing partners.** Part of the evaluation of the Environmental Trust includes lessons from MEET and other consortium partners that could help us identify best practices. Learning what does or does not work with grant making entails cooperation and transparent responses from MEET, MMCT, WCS, and IUCN. To facilitate this cooperation, we met with staff from MEET during our assessment trip. (Staff from MMCT were unavailable.) We plan to meet with consortium staff during future trips to Malawi to build rapport and an understanding of the valuable learning this evaluation can provide.

## **IX. EVALUATION OF THE ENRM PROJECT**

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The ENRM Project seeks to immediately combat excessive weed growth and sedimentation near hydropower plants through the WSM activity and address the root causes of soil erosion and runoff into the Shire through the ENRM and SGEF activities. Collectively, the project attempts to improve production and reliability of the electricity supply in Malawi. In previous chapters, we presented an evaluation approach for each activity of the ENRM Project. In this chapter, we describe our approach to evaluating the project as a whole regarding its objective of reducing sedimentation buildup in the Shire and the ultimate effect this has on hydropower production. We begin by listing the key research questions driving our evaluation, then describe our proposed evaluation design for addressing these questions, the required data sources, and our analysis approach. We conclude with a discussion of the limitations and risks of this evaluation.

The evaluation of the ENRM Project will answer four key research questions and related sub-questions, covering changes in land use practices and sedimentation levels in the Shire, overall project implementation, and sustainability of project outcomes.

- 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?
  - c) Were there any unintended consequence 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?

To address these research questions, we will use three main analytical methods: (1) remote sensing of satellite data (research question 1); (2) the Soil and Water Assessment Tool (SWAT; research question 2); and (3) a qualitative performance evaluation (research questions 3 and 4).<sup>3</sup>

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<sup>3</sup> We also considered assessing how the ENRM Project would influence water hyacinth growth in the Shire in our evaluation. However, the absence of any study that establishes a defensible relationship between soil erosion, nutrient runoff, and water hyacinth growth limits our ability to pursue that assessment. Conducting a short-term or cross-sectional analysis that relates weed growth and soil and nutrient runoff in relation to the ENRM Project would not be useful since we would not be able to account for a number of other factors (for example, propagation rate, flow regime, and evolution of inorganic fertilizer adoption rates) that contribute to that relationship. Conducting a

## A. Quantitative approaches

### 1. Remote sensing

As part of the effort to determine how land use along the Shire River has changed during the ENRM Project (research question 1), we will use high spatial resolution mapping capacities of Earth observing satellites. We will analytically determine land use and coverage in the year prior to the ENRM Project (starting in 2014), during the project (in 2018), and after the compact closes (through 2020).<sup>4</sup> This type of mapping data is called “remote sensing data,” and it has been used to monitor land surface since the early 1970s, when Earth observing satellites first came into operation. We can assess changes in land use and coverage in the Shire River watershed by classifying this remote sensing data, an analytical modeling approach used in numerous studies (see, for example, Brink and Eva 2009; Vittek et al. 2014; and Roy et al. 2014). Compared to more contemporary approaches for assessing land use and coverage changes, such as national records or ground surveys, remote sensing data offers an approach that is both consistent and reproducible (Brink and Eva 2009).

We will focus on six major classifications of land use and coverage—forests, grasslands, cropland, bare, shrubland, and woodland—as defined by the National Aeronautics and Space Administration (NASA). The definitions of the six International Geosphere-Biosphere Programme (IGBP) classifications are given in Table IX.1.

**Table IX.1. Summary of IGBP classification of land use and coverage**

Biome	IGBP definition
Forests	Woody vegetation with height more than two meters and covering at least 60 percent of land area. Forest trees divided into four categories: (i) Deciduous Broadleaf—broadleaf trees that shed leaves in annual cycles; (ii) Deciduous Needleleaf—like deciduous broadleaf but with narrow leaves; (iii) Evergreen Broadleaf—broadleaf trees that maintain green foliage throughout the year; and (iv) Evergreen Needleleaf—like evergreen broadleaf but with narrow leaves
Grassland	Lands with herbaceous types of cover. Tree and shrub cover less than 10 percent
Cropland	Lands covered with temporary crops followed by harvest and a bare soil period (for example, single and multiple cropping systems). Note: perennial woody crops are classified as forest or shrubland.
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
Shrubland	Vegetation with mainly shrubs or short trees of less than two meters. Canopy of shrubland is fairly open and allows grasses and other short plants to grow between the shrubs
Woodland	Biome with tree cover of 5–10 percent, with trees reaching a height of five meters at maturity

Source: NASA 2017.

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long-term assessment of factors that influence weed growth in the Shire would require investing considerable resources for data collection over a long period of time, which would not be feasible under the current evaluation.

<sup>4</sup> Although the Malawi Compact came into force in September 2013, the ENRM and SGEF grants did not begin implementation until August 2015 and the WSM equipment is not expected to be operational until late 2017.

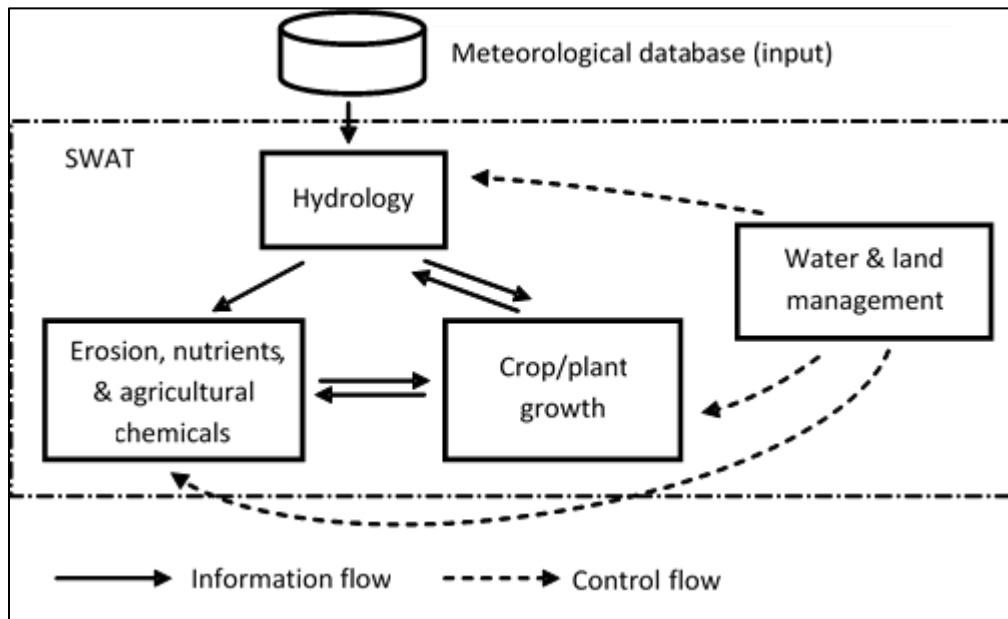
## 2. SWAT model

We can estimate how changes in land use and coverage would affect sedimentation levels in the Shire River, and resulting hydropower production, using a simulation study that considers alternative scenarios of soil erosion resulting from changes in land use management practices (research question 2). The SWAT provides a hydrological model for this (Arnold et al. 1998), which can be used to simulate sedimentation as a result of watershed activity. The SWAT model has been used by numerous studies, including Nicklow and Muleta (2001), who estimated sediment yield reductions for various soil erosion control measures, and Nkonya et al. (2014), who estimated the impact of changes in land use and management practices on sediment loadings. Adeogun et al. (2016) used the SWAT model to simulate the effect of different sediment management practices in a watershed upstream of Jebba Lake in Nigeria. This study also considered the effect on hydropower production.

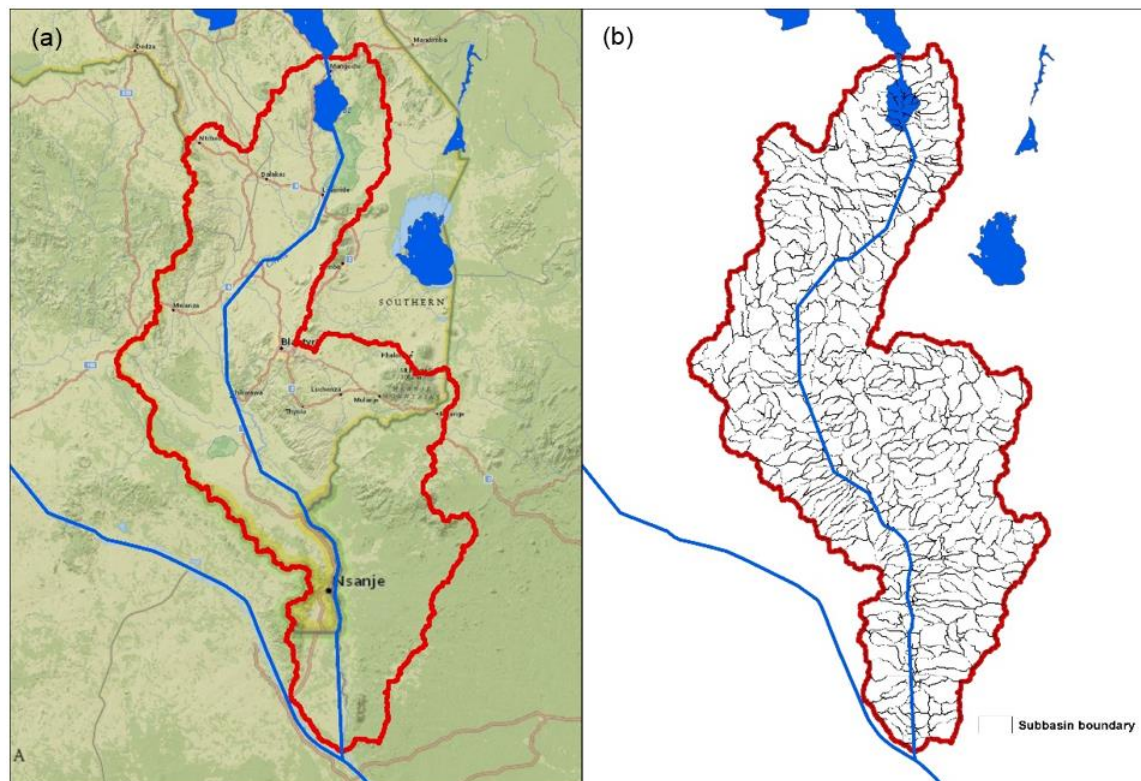
A SWAT model is implemented in two phases. The first phase creates a set of baseline simulation estimates that are used as the initial point of comparison. In this study we will estimate baseline simulations of both soil erosion and resulting sedimentation rates in the Shire River prior to changes in land management practices that resulted from the adoption of ENRM Project activities (that is, prior to August 2015, when the grants began). The second phase estimates soil erosion and resulting sedimentation rates in the Shire River under alternative scenarios of land use and coverage that resulted from changes in land use management practices (based on anticipated adoption rates of those practices post-ENRM interventions). The baseline simulations estimates are compared to those of the alternative scenarios to provide an estimate of potential changes in sedimentation rates in the Shire River under each of the proposed scenarios.

Ideally, the SWAT model should be calibrated and validated using observed data of streamflow and water quality, typically from hydrological and water quality monitoring stations. Model calibration ensures that the model parameters are finely tuned and that the highest possible level of model performance is being achieved. SWAT model validation ensures the quality of the simulated estimates by comparing them to observed data. However, due to data limitations in many developing countries, it is not always possible to fully calibrate and validate the SWAT model. In those cases, the model is considered as a tool containing transferable prior knowledge of hydrological and water quality processes, and it is still capable of providing useful simulation estimates (but with associated uncertainty).

The structure of the SWAT model is shown in Figure IX.1, while the boundary of the Shire River basin is shown Figure IX.2(a). The SWAT model will be used to divide the Shire River basin into a series of subbasins based on the topography of the watershed, shown in Figure IX.2(b). In each of the subbasins, we can further refine the basin into hydrologic response units (HRUs). An HRU aggregates areas with similar land use, land coverage, soil, and slopes, and will represent the smallest spatial unit of our SWAT model. Results from the SWAT model can therefore be presented at both the subbasin and HRU levels.

**Figure IX.1. Structure of the SWAT model**

Source: Authors' creation based on Neitsch et al. 2011.

**Figure IX.2. Boundary (red) of the Shire River watershed (a); subbasin boundaries (black) within the Shire River watershed (b)**

Source: Authors' creation using HydroSHEDS digital elevation mapping data (U.S. Department of the Interior 2017).

### 3. Data sources and data collection procedures

Both the remote sensing data analysis and the SWAT model will rely primarily on data from secondary sources. In this section we describe the data required for each method, our sources for these data, data collection timing, and data processing protocols.

#### a. Remote sensing analysis data requirements

There are currently three Earth observing satellites with high spatial resolution mapping capabilities—Landsat, Sentinel-1, and Sentinel-2. All three satellites have a lag between data capture and data availability that is equal to the frequency at which they capture images. A summary of each satellite’s capabilities is provided in Table IX.2.

**Table IX.2. Summary of remote sensing data sources**

	Landsat	Sentinel-1	Sentinel-2
Resolution (meters)	30	5 –40	10
Frequency of image capture (days)	8–16	12	10
Lag between image capture and data availability (days)	8–16	12	10
Year launched	1982	2014	2015

Sources: United States Geological Survey (2017), European Space Agency (2017a, 2017b).

Images captured by Landsat will be used to track historical land use and coverage, including land degradation and improvement. Sentinel-1 and Sentinel-2 will be used to assess the land use and coverage prior to implementation of ENRM Project activities (2014 at the earliest) and through to the evaluation period.

#### b. SWAT data requirements

The SWAT model requires data that describe the structure of the watershed, including land use and coverage, climate, and water quality. Below, we describe the data categories required for the SWAT model and our sources for each category.

- **Watershed delineation.** The hydrological data and maps based shuttle elevation derivatives at multiple scales (HydroSHEDS) provide hydrographic information—including river networks, watershed boundaries, drainage directions, and flow accumulations—at a resolution of 90 meters. This data will be used to determine the watershed delineation.
- **Watershed elevation.** The advanced spaceborne thermal emission and reflection radiometer, global digital elevation model version 2, aboard the Terra satellite, provides free, high resolution (30 meters) images of Earth as available, which can be used to create detailed maps of surface elevation.
- **Watershed land use and coverage.** No land use and coverage data sources are currently available for the Shire River; therefore we will use the results from the remote sensing data analysis, which will classify land use and coverage for the region.
- **Soil.** A 1:250,000-inch soil map for Malawi has been made available by the Government of Malawi’s Department of Land Resources.

- Daily precipitation. Observed daily precipitation data are available from 1990 to 2009 from LTS International. In addition, high resolution, near real-time precipitation data can be derived from the National Centers for Environmental Prediction (NCEP) Climate Forecast System Reanalysis (CSFR), which will allow us to extend the period of study through 2020.
- Daily temperature – observed daily temperature data are also available since 1990 from LTS International and NCEP-CSFR.
- Streamflow and sediment loading. To calibrate and validate the SWAT model, it is necessary to obtain the following observed data regarding streamflow and sediment loadings:
  - Water runoff. The driving force of soil erosion and nutrient transportation is runoff water movement. To estimate soil erosion and nutrient transportation, we will require an adequate simulation of the hydrologic/runoff generation process throughout the study region. We currently do not have data for water runoff and are working to acquire these. We have discussed the limitations of being unable to acquire this data in Section C.
  - Soil erosion and sediment siltation. There is currently no data source that provides information regarding soil erosion and sediment loadings for the Shire River. However, other studies have estimated soil erosions and sediment siltation in the Shire River (see, for example, LTS International, 2014a, 2014b, 2014c and Vargas and Omuto 2016). We will therefore use these estimates as our point of reference.
- Household demographic and socioeconomic characteristics and land management practices. This data is available through Malawi’s National Statistics Office, which conducts the nationally representative Integrated Household Survey (IHS) every five years. We will use data from the third version of the IHS, conducted in 2011, as well as the fourth version, whose data is currently being processed. We will use these data sources to calibrate alternative models of ENRM adoption.

### c. Data collection timing, processing, and quality control

We will work throughout the evaluation to collect secondary data for use in this analysis. We have begun identifying and requesting data sources as laid out in this design report. Since it is unclear how long it will take to receive the proper permissions to access data from government agencies, we will prioritize submitting initial administrative data requests in 2017. For data sources from Malawi government agencies, we will coordinate closely with monitoring and evaluation staff from MCA-Malawi to help expedite data requests and receive the government rate for any data costs. We will request data from sources outside of Malawi on our own.

The data sources listed in the previous section have been chosen because they represent the highest quality of data available for the geographical location and for the time period under consideration. By high quality we mean that the data (1) offers the best spatial resolution available, both in terms of pixels and the number of monitoring stations; (2) includes a time series that extends for several years prior to the ENRM Project, to allow for identification of trends; and (3) contains low levels of missing values.

We will follow our standard data processing protocols to ensure that the results from secondary data are accurate and reliable. We will implement similar quality control measures as



described in previous evaluation design chapters, including checking for outliers, missing values, and inconsistencies across each data set; triangulating results when we have multiple sources for the same SWAT model input measures; and ensuring that SWAT model data inputs are coming from reliable sources.

We will build the baseline SWAT model in 2018 for the time period reflected in the remotely sensed land cover data prior to the implementation of the ENRM Project, most likely 2016. From 2018 through 2020, we will develop the alternative scenarios based on data we collect during and after project implementation.

#### 4. Analysis plan

##### a. Remote sensing

To address research question 1, we will use the mapping imagery from the three satellites (described in Section 3a) to implement two methods for classifying annual land use and coverage over the desired study region. The first is a maximum likelihood classifier, an algorithm that is widely used for determining land use and coverage type (Vittekk et al. 2014; Otukey and Blaschke 2010). The second is a support vector machine classifier, an algorithm used for pattern recognition, through a supervised machine learning approach, of land use and coverage. We are proposing to use both approaches to check the robustness of our results.

Using each of the methods described above, we will classify each pixel from the satellite image into one of six designations described previously—forests, grasslands, cropland, bare, shrubland, and woodland. We will compare the changes in land use and coverage for each pixel and calculate the annual land use/cover change for each pixel.

##### b. SWAT model

The SWAT model will be used to simulate the production and transportation of sediment in the Shire River, to address research question 2. The SWAT model first calculates the daily yield of water and sediment produced from the land in each HRU and routes these items through a river channel network. The streamflow and sediment loadings at each of the designated locations can therefore be reported. The SWAT model will then be used to simulate the production and transportation of sediment in the Shire River. The core component in this SWAT model is therefore the modified universal soil loss equation (MUSLE; Williams 1975), which is used to estimate soil erosion rates given the differing land use and coverage. This equation is given by

$$SedYield = 11.8(Q_{surf} * q_{peak} * area_{hru})^{0.56} * K_{USLE} * C_{USLE} * P_{USLE} * LS_{USLE} * CFGR,$$

where  $SedYield$  is the sediment yield on a given day in tons,  $Q_{surf}$  is the volume of surface runoff given in millimeters H<sub>2</sub>O/ha,  $q_{peak}$  is the peak runoff rate (m<sup>3</sup>/s),  $area_{hru}$  is the area of the HRU(ha),  $K_{USLE}$  is the soil erodibility factor (0.013 ton m<sup>2</sup> hr/(m<sup>3</sup> ton cm)),  $C_{USLE}$  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.

The MUSLE, described here, is derived for the SWAT model from the revised universal soil loss equation (RUSLE), a widely used equation for determining soil loss. However, the soil loss equation model Southern Africa (SLEMSA) may be more applicable in this context given the location of the Shire River. To date, relatively few studies have implemented SLEMSA, and those that have do not offer a comparison between SLEMSA and RUSLE. We therefore plan to evaluate the applicability of both the RUSLE and SLEMSA erosion equations within the context of the SWAT model and will determine which is most suitable for this analysis.

The alternative scenarios for the SWAT model will be based on possible adoption rates of sustainable land management (SLM) practices included in ENRM and SGEF grant programming. Possible adoption rates will take into account both social and economic resources. We will therefore use a logistic regression of SLM adoption rates to understand the drivers of adoption and also simulate project adoption rates into future years. The SLM adoption model is given by the following:

$$SLM_{adoption} = \beta_0 + cap.endow \beta_1 + profit \beta_2 + rural \beta_3 + \varepsilon,$$

where  $SLM_{adoption}$  indicates SLM adoption at the household level;  $cap.endow$  is a vector of the household level capital endowment, which includes measures of human, physical, social, natural, financial capital, and major economic activities;  $profit$  is a vector of the household's gains or losses from adoption of SLM practices;  $rural$  is a vector of available rural services;  $\beta$  are the associated regression coefficients; and  $\varepsilon$  is the random error term. The estimated coefficients will describe the drivers in the adoption of SLM activity at the household level. What drives adoption of SLM practices can be used to identify policy strategies and implications that could increase SLM adoption rates. The feasibility of increasing the scale of SLM adoption rates can also be assessed using these drivers. If SLM practices are not profitable or are less profitable than other alternatives, then this may hinder SLM adoption rates. This can be addressed through the  $profit$  coefficient. Projected adoption rates will also take into account the operational capacity and funding plans of the Environmental Trust, so that alternative scenario simulations are based on a realistic scale of SLM practices.

By comparing the baseline simulations estimates and the estimates from the alternative scenario simulations of the SWAT model, we will have estimated the level of sedimentation in the Shire River under different scenarios of adoption of SLM practices. Using Boriji's equation (2013) for hydropower generation, we can estimate how the different levels of sedimentation produced under each SWAT model scenario would affect hydropower production, to address research question 2(a). Hydropower generation is estimated by the following

$$HEP = \eta\theta\tau \frac{hd}{3600},$$

where HEP is the amount of power generated (KWh/m<sup>3</sup>) in live storage;  $\eta$  is the overall efficiency of the power plant;  $\theta$  is the density of the water;  $\tau$  is the acceleration due to gravity; and  $hd$  is the net reservoir which is given by the total head pond at full capacity less the head pond lost due to sedimentation. The parameters  $\eta$ ,  $\theta$ , and  $\tau$  will be treated as constants in the

model. The value *hd* will be derived from the SWAT model through the baseline and alternative scenario simulations.

## **B. Performance evaluation**

In addition to examining changes in land coverage and use of the Shire River Basin and modeling scenarios for how the ENRM Project affects sediment runoff and hydropower production, we will conduct a performance evaluation to assess overall project implementation, results, and sustainability. The performance evaluation will answer research questions 3, 4, and 5 on overall project implementation, achievement, and sustainability. We have included research questions on implementation, outcome, and sustainability for each activity evaluation, as described in previous design chapters.<sup>5</sup> An overall performance evaluation of the ENRM Project allows us to synthesize findings from each activity-level evaluation in order to present an aggregated analysis of the project overall, including whether the project achieved its targeted objectives and contributed to higher-level compact goals.

No new data is being collected for this evaluation, but we are analyzing the data from each activity evaluation in a different way. To answer research question 3, we will use the implementation effectiveness framework to identify whether there were common factors across activities that were key to successful activity implementation, or whether there were common challenges that caused implementation problems, including assessing the quality of implementation. Each implementation factor will be coded into dimensions that are comparable across activities. We will also assess project implementation against the logic model (Figure II.2) to identify weak linkages, problem spots in the program logic, and which parts of the logic model were affected by implementation factors.

To answer research question 4 on overall project achievement, we will synthesize findings from each activity-level evaluation as well as results from the SWAT model analysis that will predict how SLM changes affect sedimentation run-off. We will use these results to examine if the project reached targeted intermediate and final outcomes, such as adoption of SLM practices and household income in the grant areas, overall electricity generation for the targeted plants, and plant availability. Using both outcomes data from an analysis of administrative data and qualitative data from interviews with program implementers and beneficiaries, we will assess whether observed results are due to program activities or other possible factors. We will also conduct an exploratory analysis on the extent that the ENRM Project contributed to higher-level outcomes. For instance, we will analyze data from ESCOM to examine changes to the duration and frequency of power outages before, during, and after the ENRM Project.

To answer research question 5, we will code stakeholder perceptions of sustainability from each activity into common dimensions that can be compared across activities. Data will come from both qualitative interviews and written reports on project activities. By synthesizing these results, we will be able to examine project sustainability at a more macro level, to assess the extent to which the objectives of the project—to improve sustainable land management, address

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<sup>5</sup> There is no sustainability research question for the grant facility since the Environmental Trust is being established as a way to sustain the work of the grant facility. A large part of the trust evaluation focuses on this sustainability question.

social and gender disparities, and increase hydropower productivity—will continue to be addressed after the compact closes. That is, we will examine the prospects of project outcomes fading out or being maintained and magnifying after programming ends. The dimensions of sustainability we will examine are as follows:

1. Stakeholder commitment to SLM practices: do communities targeted by ENRM grants believe in the efficacy of SLM practices and want to continue spreading the adoption of these techniques without external support?
2. Stakeholder commitment to continuing to address social and gender barriers: are women in communities targeted by SGEF grants continuing to have a larger voice in community and household decision making? Are structures such as REFLECT Circles and VSLs continuing to operate?
3. Resource availability to maintain project outcomes: have communities targeted by SGEF and ENRM grants allocated their own resources to continue similar types of activities? Does EGENCO have sufficient technical and financial support to maintain weed and sediment management equipment? Is the Environmental Trust able to sufficiently fund activities?
4. Political support for activities similar to the ENRM Project: do key government stakeholders, such as the Shire River Basin Management Program, view ENRM Project activities as a model for future work around the Shire? Has the ENRM Project influenced the Shire River Basin Management Program's strategic planning?

We will conduct this analysis once, at the end of the evaluation, for inclusion in the final evaluation report. We will use similar analytical techniques as previously described in our activity-level performance evaluations, including data triangulation across activities and thematic framing by coding activity-level findings for common themes, patterns, and issues.

### **C. Evaluation risks and mitigation strategies**

We anticipate that there will be some risks and challenges for the evaluation of the overall ENRM project. We discuss these evaluation risks here along with our proposed mitigation strategies. We will continue to update our risk assessments throughout the evaluation and adjust our mitigation strategies as necessary.

**Uncertainty in SWAT model results.** Due to data availability limitations, particularly for streamflow and sediment loading as described in Chapter V, Section B, we will be unable to perform an extensive calibration and validation of the SWAT model. This means that the results from the SWAT model will be associated with higher uncertainty compared to uncertainty levels of a fully calibrated model. This is not unusual in a developing context. To address this, we will compare our results with previous studies (LTS International et al. 2014a, 2014b, 2014c; Vargas and Omuto 2016) that attempted to establish estimates for soil erosion rates under baseline conditions in the Shire River Basin. An intermodel comparison between the estimated soil erosion risks derived for this study and previous studies will help evaluate the uncertainty associated with the model results. Agreement on the spatial pattern and magnitude of estimated soil erosion rates will increase confidence regarding the model's capacity for representing sedimentation processes in the Shire River Basin.

**Size of ENRM activities.** The Shire River basin is approximately 35,000 km<sup>2</sup> (IWMI 2015); however, the ENRM Project activities are expected to cover an area of only 10,000 hectares which is 0.3 percent of the catchment area. The final extent of the ENRM activities might therefore be too small to identify appreciable changes in sediment loading and hydropower production. To address this we plan to simulate incremental changes of ENRM activities as alternative scenarios. These alternative scenarios will be aligned with ongoing and complemented ENRM activities, the strategic plan of the planned Environmental Trust, and other ENRM funding organizations.

**Inability to attribute changes in land coverage and sediment loading to the ENRM Project.** Our evaluation of the overall ENRM Project provides remote sensing and simulated evidence of how the ENRM Project affected land use, land coverage, and sedimentation rates in the Shire River Basin. We also propose to conduct a modeling analysis to evaluate how changes in land management practices could affect soil runoff and hydropower production in the future. Although we are proposing the most rigorous methods given data and project design constraints, these methods do not allow us to estimate causal effects of the ENRM Project.

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## **X. ADMINISTRATIVE CONSIDERATIONS**

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Given the complexity of this multicomponent project and evaluation, careful management of the evaluation and timeline is essential. In this section, we discuss several administrative issues relevant to the conduct of the evaluation and present a timeline for evaluation activities.

### **A. Summary of IRB requirements and clearances**

Mathematica is committed to protecting the rights and welfare of human subjects and will obtain approval from an institutional review board (IRB) for relevant research and data collection activities. IRB approval requires three sets of documents: (1) a research protocol, in which we describe the purpose and design of the research and provide information about our plans for protecting the confidentiality and human rights of study participants, including how we will acquire consent for their participation; (2) copies of all data collection instruments and consent forms that we plan to use for the evaluation; and (3) a completed IRB questionnaire that provides information about the research protocol, how we will securely collect and store our data, our plans for protecting participants' rights, and any possible threats to participants resulting from any compromise of data confidentiality. We anticipate the IRB review of this study to qualify for expedited review as it presents minimal risk to participants. IRB approval is valid for one year, and we will submit annual renewals for subsequent year approvals as needed.

In addition, we will ensure that the study meets all U.S. and Malawi research standards for ethics in consultation with MCC. We will submit the research protocols and instruments to our U.S.-based IRB, and the Malawian data collection firm hired by Mathematica will obtain permits or clearances from the relevant Malawi government offices before starting fieldwork. If the U.S. IRB or Malawian authorities recommend changes to protocols or instruments, the data collection firm, MCC, and Mathematica will work together to accommodate the changes, and all parties will agree on the final protocol before data collection begins.

Since some of our focus groups and key informant interviews could involve discussions around sensitive information, such as the treatment of women, we will have the data collection firm follow Malawi and international survey protocols for reporting on gender-based violence (GBV). Disclosure of possible GBV reporting will be included as necessary in our IRB application and data collection training will include a specific module on what steps surveyors should take in response to GBV disclosures, including providing information to respondents on available support resources they can access and completing anonymous adverse event forms. Surveyors will notify respondents prior to commencing the interview that they are required to report disclosures of GBV to the proper authorities.

### **B. Data access and privacy**

All electronic data is encrypted in transit and at rest. Sensitive data is stored (segregated) into a designated encrypted project folder that is secured with AES 256-bit encryption. Access is restricted through the use of access control lists. Access to the project folder is authorized by the project director on need-to-know and least-privilege bases. Data stored in the designated restricted folder is easily identifiable to authorized staff for data return or destruction purposes. Project staff are instructed to maintain all files with confidential data in these project-specific,

encrypted folders on the Mathematica network. In addition, Mathematica utilizes a host-based intrusion detection system and firewall provided by Symantec Endpoint Protection.

### **C. Dissemination plan**

To ensure that the results and lessons from the evaluation reach a wide audience, we will work with MCC to increase the visibility of the evaluation and target findings to relevant policymakers and practitioners in land management, agriculture, women's empowerment, and electricity sectors. We have already developed relationships with key project stakeholders during our design assessment trip, including staff from EGENCO, MEET, and ENRM and SGEF grantees. We will share our final design report with these and other project stakeholders, including Malawian government officials, to inform and engage them in the evaluation process and solicit their feedback. We will present our evaluation design to staff from MCC, MCA-Malawi, and project stakeholders either in person or remotely. After completing the interim and final report, we will present findings in person to MCC in Washington, DC, and, if possible, to key stakeholders in Malawi. The interim and final evaluation reports will be available online on the MCC website within six months of their submission.

We expect the broader research community to have strong interest in the findings from the evaluation. To facilitate wide dissemination of findings and lessons learned, we will collaborate with MCC and other stakeholders to identify additional forums—conferences, workshops, and publications—in which to disseminate the results, and we will encourage other donors and implementers to integrate the findings into their programming.

### **D. Evaluation team: roles and responsibilities**

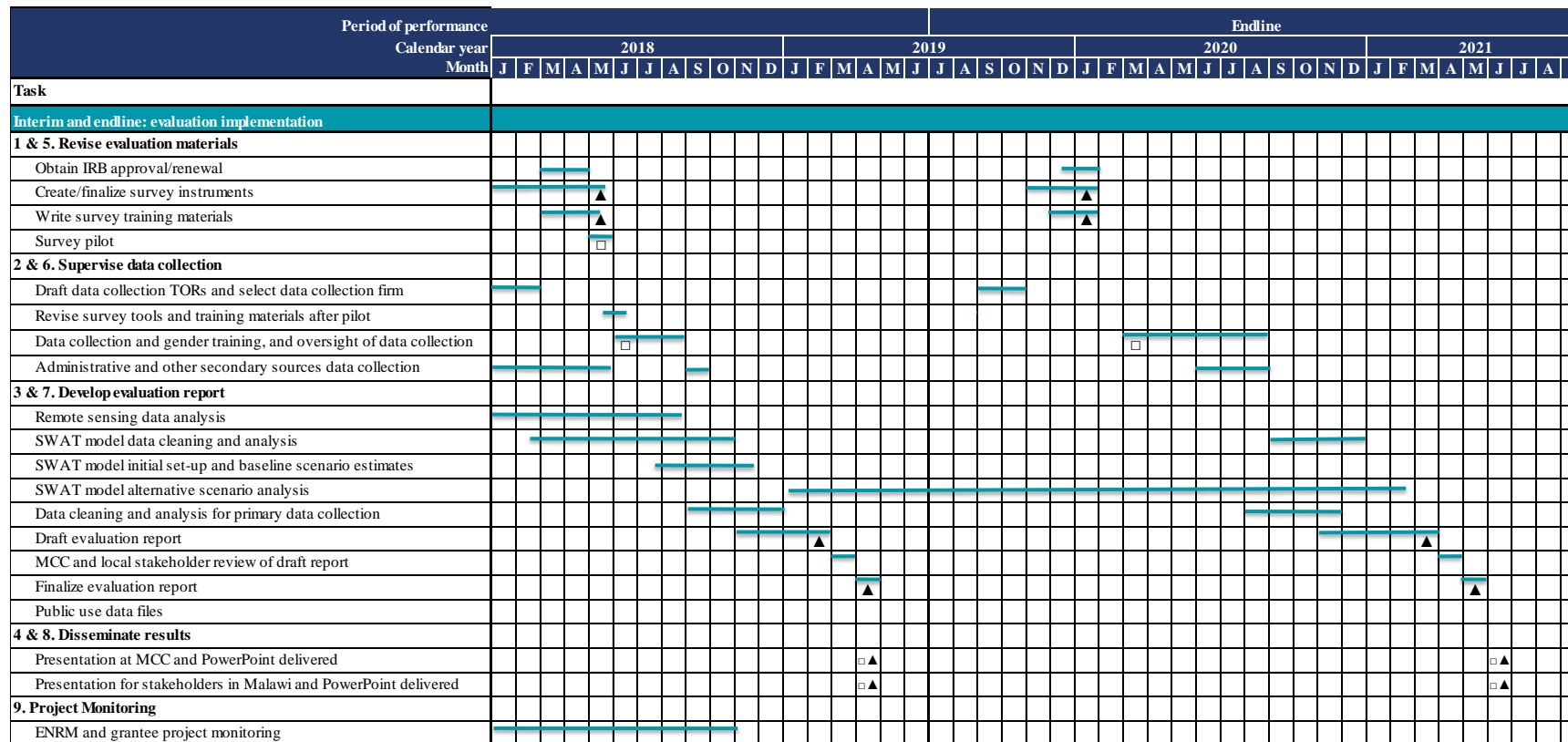
Our team will contribute extensive experience and expertise to meet MCC's evaluation needs. **Mr. Matt Sloan** leads the team as the program manager and oversees the design and implementation of the evaluation. He assumes primary responsibility for coordinating deliverables and for ensuring the on-time completion of tasks within budget and with high quality. **Dr. Claudia Ringler** serves as the ENRM expert, responsible for the technical and methodological leadership of the evaluation and modeling of land-use change in the Shire River Basin. **Dr. Ephraim Nkonya**, the agriculture extension specialist, will focus on analyzing the ENRM grants, including the type, magnitude, and timing of benefits. **Dr. Arif Mamun** directs the development of the evaluation design and is the team's lead economist. He will estimate the impacts of the WSM activity using an ITS design. **Mr. Thomas Coen** supports Dr. Mamun in the technical design process and data analysis and led the evaluability assessment effort. **Dr. Hua Xie** serves as the lead hydrologist and will design the SWAT model for the evaluation. **Ms. Yating Ru** serves as the GIS specialist and is supporting the SWAT model design. **Dr. Kristen Velyvis** serves as the social and gender expert, leading the SGEF aspects of the evaluation; she is the qualitative methods expert for the data collection activities and evaluation. **Mr. Luytamy Mwamlima** is a local consultant who works closely with Mathematica and local stakeholders to facilitate logistics for data collection, including on-the-ground oversight of the qualitative data collection. **Ms. Anca Dumitrescu** supports Dr. Velyvis with the design of the qualitative assessment, including leading instrument development and data collection. **Ms. Naomi Dorsey** manages the project internally for Mathematica and supports research tasks.



**E. Evaluation timeline and reporting schedule**

Figure X.1 presents our evaluation activities, including instrument development and data collection, quantitative and qualitative data analysis, report writing, and dissemination for both the interim and final reports. We will closely monitor risks to completing deliverables on time, including changes to the ENRM Project and its implementation schedule, as well as the political and economic environment in Malawi. If any of these factors will affect our evaluation timeline, we will discuss them in advance with MCC.

**Figure X.1. Evaluation timeline**



□ Travel  
 ▲ Report/deliverable

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## **APPENDIX A**

### **TABLES**

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**Table A.1. MCA-Malawi monitoring indicators for ENRM and SGEF grants**

Indicator level	Indicator
Output	Community members engaged in ongoing community-level dialogues <sup>a</sup>
Output	Traditional leaders trained on social and natural resources management issues <sup>a</sup>
Output	Area and village development committee trained on social and natural resources management issues <sup>a</sup>
Output	Women provided with leadership training
Output	Women and men who are members of community- or village-level committees <sup>a</sup>
Process	Temporary employment generated <sup>a</sup>
Process	Goats procured and distributed <sup>a</sup>
Process	Trees planted
Process	Trees survived
Process	REFLECT/reflection-action circles established and operational <sup>a</sup>
Process	REFLECT/reflection-action circles facilitators identified and operational <sup>a</sup>
Process	REFLECT/reflection-action circles classes established and operational <sup>a</sup>
Process	Legal aid provision visits
Process	Land under conservation
Process	Lead farmers trained <sup>a</sup>
Process	Village natural resource management committees' capacity strengthened
Process	Village savings and loans established and operational <sup>a</sup>
Process	Village savings and loan management committees trained in village savings and loan concept <sup>a</sup>
Process	Village savings and loan, business management, marketing manuals, and village savings and loan kits procured
Process	Village agents identified and operational <sup>a</sup>
Process	Training in business management and marketing <sup>a</sup>
Process	Men as change agents trained and operational
Process	Village and area development committees trained <sup>a</sup>
Process	Coordination meetings conducted
Process	Video documentation of case studies
Process	Project monitoring visits
Output	Community members engaged in ongoing community-level dialogues

Source: Adapted from Millennium Challenge Account-Malawi 2017.

<sup>a</sup>Indicator also reports gender disaggregated results.

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