Scaling-up water management interventions for rainfed agriculture in the Ethiopian Highlands: status, issues, and opportunities

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Summary

Ethiopia is the second most populous country in Africa with more than 110 million people. The capacity to feed its rapidly growing population largely depends on rainfed agricultural production systems, in a range of agro climatic regions from arid and semiarid lowlands to temperate highlands. Agriculture is undermined by both severe land degradation and high inter- and intra-seasonal rainfall variability. As a result, the current average productivity of rainfed farming remains low (1.7 t ha^{-1} for pulses and 2.7 t ha^{-1} for cereals). This is despite a slow yield increase (e.g. about 1.5 t ha^{-1} for cereals and 1 t ha^{-1} for pulses) due to the introduction of new crop cultivars, fertilizers and management practices. Recognising the large yield gap in rainfed systems, the Ethiopian government has, since 1970, initiated a number of public welfare programs. These have involved various natural resource management programs with a special focus on agricultural water management (AWM) in Sustainable Land Management Projects (SLMP). SLMPs, centered around rainfed production systems, have been implemented to address land degradation, enhance crop and livestock productivity, and improve household incomes. Integrated resource management approaches have helped local communities obtain tangible benefits from AWM, and strengthened a number of ecosystem services, when compared to a sectoral approach. In the last 15 years, through SLMP 1 and 2, more than 2% of agricultural fields, and communal rainfed land, in Ethiopia, has been subject to AWM and sustainable land management. This has benefitted around 1.4 million households and supported environmental sustainability. Over 430,000 people have also benefited from related income generating activities. However, systematic data on various aspects of AWM is required to obtain a clear understanding of the overall impact of these interventions. This study proposes following a landscape approach, in order to realize the full potential of diverse AWM interventions, and a consortium approach to capacity building to achieve large scale, system level outcomes.

1. Introduction

Food and water insecurity and land degradation are some of the major challenges of the 21st century. Land degradation affects about 30% of total global land area, and around three billion people reside on degraded land (Nkonya et al., 2016). Ethiopia, the second most populous country in Africa with a population of 110 million, is affected by land degradation (Gashaw et al., 2014; Abera et al., 2019). A rapidly growing population, inappropriate land management, rigid land tenure, along with industrialization and urbanization have significantly impacted land use patterns. Endowed with abundant natural resources, Ethiopia has one of the most diverse agro-ecological configurations in the world. With 74.3 million hectares of arable land, spread over 18 major agro-ecological zones at altitudes ranging from 148 meters to 4,620 meters above sea level, the country's diversity makes it suitable for growing a wide range of crops (ATA, 2019). Around 80% of the population of Ethiopia live in rural areas. Agriculture is the dominant economic sector, accounting for 35% of Gross Domestic Product (GDP), 65% of employment, and over 80% of the country's export value (World Bank, 2019; Central Statistics Agency, 2018).

Ethiopia has serious land degradation challenges due to anthropogenic activities. As more forested and protected areas have been converted to crop and grass land, there has been a significant decline in the ecosystem services these provide. Per household land holding size has also been decreasing. The landscape of Ethiopia has been transformed through this land use change (Kassawmar et al., 2018). Soil losses of around 3-85 t ha^{-1} year^{-1}, and as high as 300 t ha^{-1} year^{-1}, have been reported (Gashaw et al., 2014; GIZ, 2015; Hurni et al., 2015). The annual cost of land degradation, associated with land use and land cover change, is estimated to be around $4.3 billion (Gebreselassie et al., 2016). Cultivated land is more vulnerable to soil losses, ranging from 50-180 t ha^{-1} year^{-1}, due to various tillage approaches and the often steep slopes (Shiferaw and Holden, 1999; Adimassu et al., 2002). This has resulted in nutrient losses of 10-120 kg ha^{-1} year^{-1}, siltation of downstream reservoirs, and productivity losses in the uplands (Adimassu et al., 2002; Gebrehiwot et al., 2013). For example, heavy soil erosion (380 million tons annually) from upland areas of the Upper Blue Nile basin have caused serious siltation at the Great Ethiopian Renaissance Dam reservoir, reducing its live storage capacity (Hurni et al., 2015). The substantial loss of highly fertile top soil affects rainfed systems, further reducing production capacity, as soil nutrients and organic matter are lost. Rainfall in Ethiopia is characterized by high spatial variability, from 400 mm in the Somali region to 2300 mm in the Benishangul-gumuz region (Gummadi et al., 2017), with large year to year variability (Alhamshry et al., 2020). Except for a tendency towards increased main season rainfall (JJAS) in some parts of north eastern and south western Ethiopia (Gebrechorkos et al., 2019), rainfall analysis does not currently indicate any other significant trend. The large year to year rainfall varaibility may bring more uncertainty in terms of water resource availability, and the frequency of droughts or flood events. Maintaining and increasing rainfed production under changing rainfall patterns is therefore a critical priority, alongside the urgent need to reverse land degradation and rebuild soil health.
Despite rapid economic development in the last two decades, poverty and food insecurity have remained serious challenges. In response, the Government of Ethiopia (GoE) implemented structural transformation through two phases of its Growth and Transformation Plan (GTP). GTP-I (2010-2015) targeted Ethiopia's long-term goal of becoming a middle-income country by 2025. Ethiopia achieved a growth rate goal of 10% per year during this period, which was close to its goal of at least 11%. Achievements and implementation lessons from GTP-I informed the formulation of the Second Growth and Transformation Plan (GTP-II), implemented 2016-2020.

GTP-II priorities for natural resource management capitalized on initiatives in the Climate-Resilient Green Economy (CRGE) Strategy, launched by the GoE in 2011. These seek to concurrently foster economic development and growth, reductions in greenhouse gas emissions, and improved climate change resilience. A major investment area of both GTP-I and GTP-II was

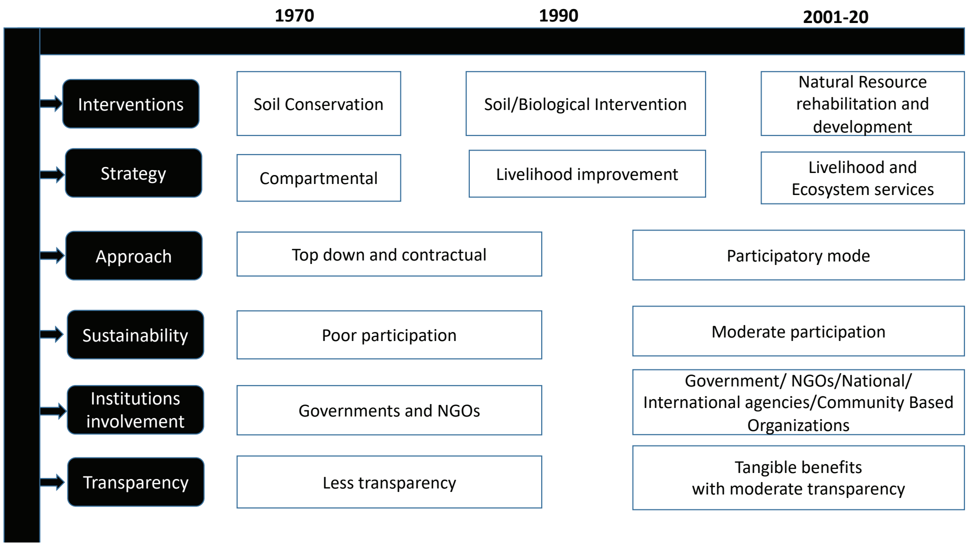

Figure 1: Journey of the Ethiopian land restoration program since 1970s onwards.
Source: Authors' elaborations based on literature review.

in tackling land degradation and the rehabilitation of watersheds and degraded landscapes. The GoE has attempted to address land degradation through various soil and water conservation measures (Figure 1), investing around US$8 billion since the 1970s (Figure 2) (Adimassu et al., 2018; Nedessa and Wickrema, 2010). Ethiopia, and its development partners, have invested more in improving water and land management than any other country in Africa (Merrey and Gebreselasse, 2011).

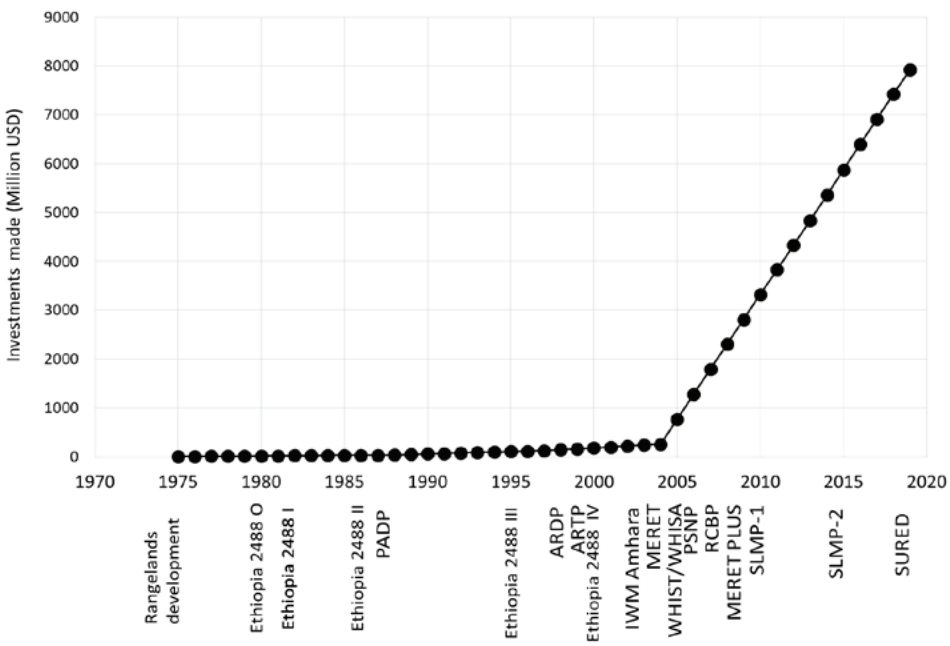

Figure 2: Investment made in key agricultural water management programs in Ethiopia from 1975 to till date. (Adimassu et al., 2018; Nedessa and Wickrema, 2010)
Note: Due to lack of information, small grants from locally operating NGOs and contributions from the community is not included in this calculation of investment.

The Sustainable Land Management Program (SLMP), a flagship program of the Ministry of Agriculture, was designed under the long-term (2009-2023) Ethiopian Strategic Investment Framework (ESIF) for Sustainable Land Management. SLMP was implemented in two phases; SLMP-1 (2009-2013) and SLMP-2 (2014-2019). SLMP-1 focused on sustainable land management (SLM) practices in 45 pilot watersheds, in six regions; Amhara, Tigray, Oromia, SNNP, Gambella, and Benishangul Gumuz. During SLMP-2 this was extended to 135 major watersheds, including the first 45 of SLMP-1 (Center for Development Research, 2019; Water and Land Resource Centre, 2018). The GoE and various development partners including; *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ), the World Food Programme, the African Highlands Initiative, Menschen für Menschen, Save the Children, Catholic Relief Services and many others have invested in watershed management.

This case study focuses on assembling and synthesizing existing information on land and water management for scaling-up AWM interventions in the Ethiopian Highlands. This study describes the national program of SLM, which is the main national initiative to address production capacity in the predominantly rainfed, agricultural production systems of Ethiopia. The main objective is to distil lessons to inform policy. This study also examines the current status of watershed interventions of various initiatives to assess their impact and scope for improvement.

Evolution of approaches in agricultural water management

Ethiopia is a particularly diverse country in terms of agro-ecology, range of elevations, farming systems, landscapes and production systems. All of these aspects affect the natural resources base, in particular the quantity and distribution of agricultural water resources. Land degradation in these diverse systems may require a range of management solutions. Raising awareness and mobilizing communities are the key to rehabilitating degraded landscapes in Ethiopia (Amede, 2003).

During the evolving journey of land restoration in Ethiopia, a number of technologies and practices have been adopted by smallholder farmers. This includes a range of soil and water conservation practices, *in situ* interventions (bunding, terracing, pits, diversion drainage ditches, conservation agriculture practices) and *ex situ* interventions (check dams, cut-off drains, and various gully control structures), together with biological interventions (tree planting, agroforestry, silvi pasture). *In situ* interventions harvest surface runoff locally in the field, enhance soil moisture availability, and control soil erosion. *Ex situ* interventions harvest a significant amount of surface runoff, and control land degradation, mostly in stream networks. Agroforestry interventions strengthen *in situ* interventions and address short and long-term productivity goals.

During the initial phase of the land restoration program, in the 1980s, the Ministry of Agriculture and World Food Program (WFP), with technical support from the Food and Agriculture Organization of the United Nations (FAO), implemented a development project named: Rehabilitation of Forest, Grazing and Agricultural Lands (Project 2488). The predominant focus was on physical soil conservation practices (Table 1). A top-down, contractual approach was followed, which resulted in less planning and execution process transparency. In the 1990s, during the next phase of the land restoration program, the focus was also on agriculture development through the introduction of the Peasant Agricultural Development Program, along with later phases of the Rehabilitation of Forest, Grazing and Agricultural Lands project. The primary objectives of the project were to increase; the production of food grains, soil productivity, and the incomes of rural, smallholder farmers. Over its five phase, 20-year lifespan, efforts made through Project 2488 have been successful in afforestation, addressing feed and fodder availability, soil and water conservation, and agricultural productivity through landscape treatment (Nedessa and Wickrema, 2010). Consequently, it laid the foundation for the Managing Environmental Resources to Enable Transition (MERET) program. From 2000, many more integrated natural resource management programs were initiated to strengthen institutional capacity, address poor productivity, and improve livelihoods, by introducing a holistic approach. This has ensured improved participation and tangible stakeholder benefits. These programs were supported by multiple donor agencies, as well as by national and international agencies (Table 1). Building on initial pilots, GoE and WFP merged farmer priorities with technical specifications for watershed and farm (field) soil management in rainfed production systems. The result was the Local Level Participatory Planning Approach which developed into the MERET program, under the auspices of the Productive Safety Net Program (PSNP) (Tongul and Hobson, 2013). PSNP was implemented by GoE, with assistance from development partners. The program has been widely studied and found to have positively impacted food-insecure households (Weltejii et al., 2017; Rashid et al., 2013). Households that received technology

Table 1: A snapshot of projects and programs related to sustainable land management activities in Ethiopia.

Time period	Program	Donors
1975-1985	Rangelands Development Project	WB
1980-1982	Rehabilitation of Forest, Grazing and Agricultural Lands (Ethiopia 2488 original)	WFP, FAO
1982-1987	Ethiopia 2488/ Phase I	WFP, FAO
1988-1994	Ethiopia 2488/ Phase II	WFP, FAO
1995-1998	Ethiopia 2488/ Phase III	WFP, FAO
1999-2002	Ethiopia 2488/ Phase IV	WFP, FAO
2003-2006	MERET	WFP
2007-2011	MERET plus	WFP
1988-1997	Peasant Agricultural Development Program	WB
1997-2008	Sida-Amhara Rural Development Program	SIDA
1998-2005	Agricultural Research and Training Program (ARTP)	WB
2004-2009	Integrated Watershed Management in the Amhara Regional State	Government of the Netherlands
2005-2020	Productive Safety Net Program (PSNP)	Multilateral
2005-2011	Water Harvesting and Institutional Strengthening in Tigray (WHIST)	CIDA
2005-2011	Water Harvesting and Institutional Strengthening in Amhara (WHISA)	CIDA
2006-2012	Rural Capacity Building Project (RCBP)	WB
2008-2013	Sustainable Land Management Program (SLMP-1)	WB, GEF, GoE, FAO
2014-2019	Sustainable Land Management Program (SLMP-2)	WB, GEF, GoE, FAO, GIZ
2018-2020	Sustainable use of rehabilitated land for economic development (SURED)	GIZ, EU

(Adimassu et al., 2018; Nedessa and Wickrema, 2010)

Note: CIDA: Canadian International Development Agency; WB: The World Bank; GEF: Global Environment Facility; GoE: Government of Ethiopia; FAO: Food and Agriculture Organization of the United Nations; GIZ: Deutsche Gesellschaft für Internationale Zusammenarbeit; SIDA: Swedish International Development Cooperation Agency, WFP: World Food Program packages of agricultural support were found to more likely be food secure (Gilligan et al., 2009). In 2008, a major breakthrough came with the formulation of the Ethiopian Strategic Investment Framework for the Sustainable Land Management Program which aimed to guide government and civil society stakeholders towards promoting SLM planning and investments, to address linkages between poverty and land degradation (Merrey and Gebreselassie, 2011; Abera, 2019). Ethiopia's SLMP is designed to address concerns about the production capacity of rainfed cropland, including associated deforestation, with technical support from GIZ. SLMP contributes to mitigation of land degradation and improvement of crop productivity, in selected watersheds, of target regions of Ethiopia.

A large proportion of the population of Ethiopia is landless with limited, or no, participation in adoption of SLM measures. Previously there was little clarity in the land tenure system, whereby all land belongs to the government. Especially common land held unclear tenure arrangements. This hindered the participation of many land users. Recognizing this, GIZ together with the EU, initiated the Sustainable Use of Rehabilitated Land for Economic Development (SURED) project in 2018. The aim was to add value to rehabilitated land under SLMP through increased productivity and market linkages for products and services, from the restored landscapes.

2. National actions for rainfed intensification from farm to landscape

A strong foundation for the SLMP projects has been laid since 1970 through the legacy of good practices from successive projects, including two decades of actions through the Ethiopia 2488 project, and successor projects MERET and MERET PLUS (2003-2011) (Amede et al. 2007). The key common components of these projects have been:

i. selection and prioritization of watersheds;
ii. engaging local officials and negotiating with the community;
iii. inventory assessment and constraint and opportunity analyses;
iv. developing base and development maps;
v. identification and prioritization of innovations;
vi. implementation; and
vii. participatory monitoring and evaluation.

SLMP-1 (2008-2013) introduced SLM practices in selected areas through an integrated approach beyond individual farmers' fields. It helped to rehabilitate degraded land which had previously been stripped of its economic value and was considered unproductive. SLMP-1 supported a comprehensive, strategic approach to improved natural resource management over 190,000 ha, involving 98,000 rural households.

SLMP-2 (2014-2019), was based on the implementation experience and results of SLMP-1. SLMP-2 was implemented through three thematic components: (i) Integrated Watershed and Landscape Management; (ii) Institutional Strengthening, Capacity Development and Knowledge Management; and (iii) Rural Land Administration, Certification, and Land Use. SLMP is currently planning a rapid impact assessment of previous phases before it continues to the next phase, which is expected to be implemented up until 2023 (from personal discussion with project leader). A schematic description of the thematic components, interventions, outputs and impacts is given in Figure 3.

Working with principles of natural resource management for rainfed crop and pasture land

The major entry point in SLMP-2 was supporting farmers within the watershed boundary. It involved the adoption and scaling up of best-fit, sustainable land and water management technologies and practices by smallholder farmers in selected watersheds/woredas, on both private fields and community land. A total of 874,300 ha of land, across 135 watersheds (2.5% of the total crop and pasture land of Ethiopia), was planned to be convert to SLM practices by the end of

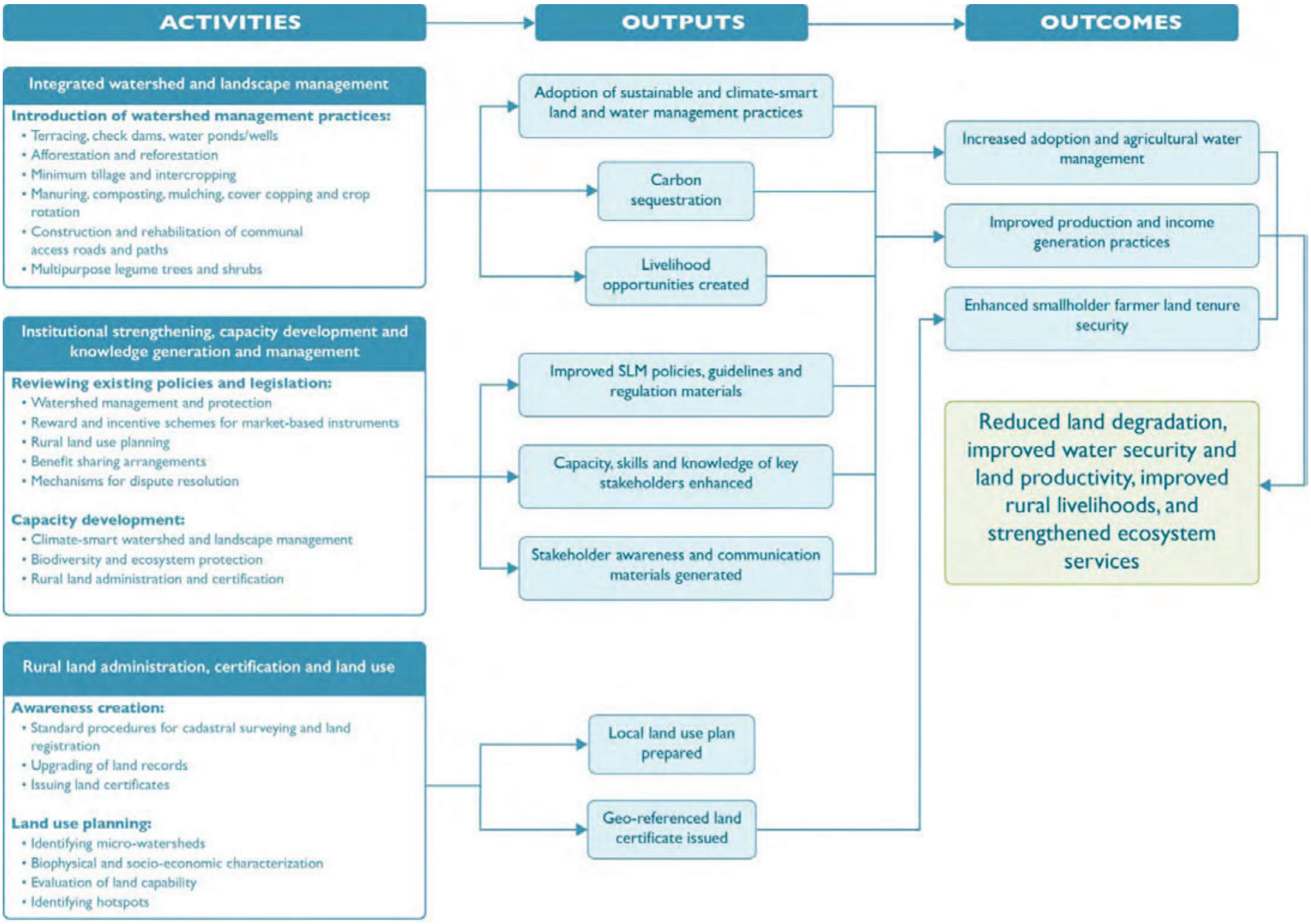

Figure 3: SLMP-1 (2008-2013) and SLMP-2 (2014-2019) theory of change (Source : World Bank, 2019; 2020)

SLMP-2. 98.5% of the plan was achieved through investments made to implement SLM on 861,400 ha. On the communal lands 665,500 ha was treated using various physical structures. Various biological, soil and water conservation (SWC) measures were implemented across 75,000 ha (80%) of hilly areas (Box 1). The project treated about 65% of the total 142,200 ha of degraded land reported in the baseline study of the 135 watersheds. Consequently, about 709,400 households, of which 202,000 (28%) were female headed households, benefited directly from physical and biological structures on communal land.

Landscape and community level interventions

Gully rehabilitation was an important intervention under SLMP. Around 5,500 ha of gully areas were treated using various measures including reshaping and biological re-vegetation. 3,000 ha of gully areas were restored and converted to productive land, equating to 74% of the total planned for. This investment benefited around 43,600 households directly (of which around 8,500 were female headed) by enabling the use of restored gulley areas for fodder and fruit production.

Box 1: Soil-water-biological practices

Soil and water conservation measures are helpful for arresting surface runoff, controlling soil ero-sion and land degradation. SWC along with biological interventions such as afforestation, agrofor-estry and fodder production, brings sustainability to the system. Field bunding, trenches, and ter-racing are important *in situ* interventions, whereas farm ponds and check dams, are important *ex situ* interventions. The photos below represent of some of these measures.

Source: Center for Development Research, 2019. Photo from 2019 trip and documentation.

SLMP-2 implemented community forest management activities based on a communal land use plan. This focused on improving existing forest management practices, promoting afforestation and reforestation activities, and measures to reduce forest degradation.

About 16,000 ha (82% of the target) was delineated as under existing community forest management. Community forest management benefited around 71,600 households through afforestation and reforestation on non-agricultural lands, 131% of the project target. Around 22% of these households were female headed. Nearly, 17,600 ha (99.7% of the target) were covered by bamboo. To support supply of sufficient planting materials, the SLMP invested in the establishment and management of 22,500 ha (99.5% of the planned target) of nursery sites across the SLMP watersheds of the six regional states. Some of the nurseries were managed centrally whereas others were managed individually or by a group. Around 384 million seedlings were grown in these nurseries, equating to 102.63% of the target. Community pastureland management was another landscape level SLMP intervention. From a total pastureland area of 5,600 ha in the project watersheds, 4,500 ha (80%) had been treated with both physical and biological measures as of September 2018. The treated pasture land area served over 345,000 livestock.
SLMP also invested in supporting community infrastructure developments. These included; water-harvesting structures, introduction of water lifting structures, and construction of diversion weirs, potable water supply schemes and community roads. The project developed 803 small-scale irrigation schemes, benefitting around 20,700 households (of which 17% were female headed). Construction of community roads improved access to 603 micro-watersheds, achieving about 98% of planned targets.

Farm/household level interventions

SWC measures on farmland, which can be considered good AWM practices, were a key investment area of SLMP interventions. During the project period, 137,200 ha of farmland was treated using physical SWC measures, of which 83,700 ha was also covered by biological SWC measures. A total of around 363,500 households benefited from this farmland treatment, accounting for 99% of the project target. This equates to 66% of the total number of households in the 135 watersheds. About 26% of beneficiaries were female headed households. The areas and beneficiaries of some selected interventions are presented in Table 2.

This project also implemented climate smart agriculture (CSA) activities, contributing to adaptation, mitigation and food security efforts. These are part of SLM technologies, with the potential to improve soil fertility and promote and

Table 2: Implementation of integrated watershed management interventions on selected land units

Particulars	Area (ha)	No. of households benefited
Communal land area covered by physical structures	95,460	740,800
Communal land area covered by biological measures	79,360	
Forest area demarcated	16000	71,600
Bamboo (natural + plantation)	27600	
Small scale irrigation	4730	20,700
Potable water	137,150	363,500
Conservation agriculture	37,200	150,600
Backyard livestock farming		63,800
Apiculture		10,800

Source: Center for Development Research, 2019

produce high value crops. These practices were implemented on 37,200 ha, benefitting around 150,600 households, 21% of which were female headed. Around 9,500 ha received other CSA measures, such as green manuring and cover crops, 56,600 ha received compost, and 7,300 ha were treated with agroforestry practices.
As part of good practices aimed at promoting the adoption, sustainability and resilience of SLM technologies, open grazing was controlled. To realize this, SLMP-2 invested in fodder/forage production, poultry promotion, as well as fattening and breed improvement activities. Consequently, 63,800 households benefited from improved backyard livestock management, 55,100 households applied a cut and carry feeding system, and 18,100 households were involved in livestock breed improvement. Female headed households benefiting from backyard livestock management accounted for 22.9% of the total. 19% of female headed households benefited from cut and carry feeding systems, and 23% from using improved livestock breeds.

Developing incentive systems, and integrating income generating strategies into natural resource management practices, are necessary to maintain commitment to SLM investments (Amede et al., 2007). Apiculture was promoted as an alternative income generating activity, benefitting several households. This benefited from watershed management interventions involving area closures, afforestation and enrichment plantation, among others. As a result of apiculture promotion in the 135 SLMP-2 watersheds, a total of 210 tons of honey and 12 tons of wax were produced. This benefitted 10,800 households, of which 19.7% were female headed.'

Rural land administration, certification and land use

Rural land administration and certification was implemented to enhance smallholder farmer tenure security in the project area. There is evidence that this 'first-stage' land registration has had a positive effect in terms of increased investment, land productivity and land rental market activities. The government has since initiated another round of land registration and certification that involves technically advanced land survey methods and computer registration (Bezu and Holden, 2014). An important incentive to increase farmer and landowner motivation to adopt sustainable land and water management practices in individual fields was to increase tenure security (Table 3). This increases farmer confidence to invest in long term solutions.

Table 3: Summary of land registration and certification achievements

No	Indicator/activity	Target	Achieved
1	Number of communal lands surveyed and mapped for certification	23,525	39,168
2	Number of certificates issued for communal land	19,996	21,277
3	Parcels of land surveyed and mapped for certification	1,917,325	1,695,636
4	Individual parcels surveyed and mapped for certification	1,893,800	1,656,468
5	Number of households issued with geo-referenced map-based certificate	473,450	410,205
6	Women who received 2nd level certificate Individually or jointly	340,088	287,144
7	Landless youth who have been issued a second level certificate	9,504	11,259
8	Landless female youth received land certificate	1,544	3,264

Source: Center for Development Research, 2019

Local level participatory land use plans were prepared in 545 kebeles[1] to ensure engagement and ownership. This also enabled the design of measures in a collaborative way, helping to ensure context specific implementation directly including the voice of farmers.

Project management and funding

As per the framework agreement for SLMP-2 implementation, the Ethiopian Government was responsible for ensuring that the project achieved its development objectives. The World Bank was required to make arrangements to ensure that loans and credit given were used only for the purposes for which they were intended. SLMP implemented a project management approach, that clearly set coordination, and monitoring and evaluation, processes, to achieve success.

SLMP-2 had a coordination structure, from federal to kebele level, following the structure of the government extension system. At the federal level, a national project coordination unit was established, composed of a multidisciplinary team (specialists in monitoring and evaluation, watershed management, land administration, safeguarding, infrastructure, procurement and finance), led by a national coordinator. A similar coordination setup was implemented, with key specialists, at regional level, and focal persons led coordination at woreda level. SLMP-2 had steering and technical committees at federal, regional, woreda, kebele and community levels, to facilitate and implement interventions.

Community participation was an important element of the design and implementation of SLMP (Amede et al., 2007). A household survey indicated that the majority of the community (69%) had participated in the SLM planning process, enabling them to prioritize their needs and interests (Center for Development Research, 2019). A total of 5,897 formal community-based institutions, self-help groups and associations were established, and made functional, across intervention areas. About 431,300 people participated in income-generating activities under the implementation process. Similarly, 399,735 households are reported to have used at least three SLM technology packages on individual household lands in 2017 and 2018, suggesting a good adoption rate (Center for Development Research, 2019). Various capacity building, training and experience sharing, visits were conducted. These targeted the various components of the project at different levels. These adoption rates, supported by the capacity building, are good indicators of sustainability.

SLMP-2 put in place a web-based monitoring and evaluation (M&E) system for management and documentation of project results, at all levels (community, kebele, woreda, region and federal). The system had a planning and reporting tool, as well as M&E elements. However, a major limitation was that no comprehensive benchmarking was conducted at the start of each phase of the project. Furthermore, most of the assessments and success stories were conducted based on stakeholder feedback, without any triangulation through objective measurement of the changes. Therefore, a critical impact assessment is required to support the M&E findings.

There are also difficulties in assessing the actual investments made in SLMP activities, and associated PSNP programs. Both public and donor funding contributes to several components in each of the different regions. In addition INGOs, and other research institute linked activities, for example CGIAR programs and bilateral initiatives such as the R4D partnership with the Netherlands, benefit (Schmidt and Tadesse, 2019). One estimate suggests that between 2009-2013, the World Bank, the Global Environment Facility, the Government of Ethiopia and FAO funded a total of at least US $37.79 million to implement SLMP-I. Whereas, between 2014 and 2019, a US $94.65 million investment was made in SLMP-2 by these same funders plus GIZ (Adimassu et al., 2018).

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[1]*kebeles: the smallest administrative unit in Ethiopia, that may contain several watersheds.*

3. Impact on agricultural production and various ecosystem services

Improving water security and productivity

SLMP-2 influenced agricultural production systems by enhancing infiltration upstream, and increasing water resource availability downstream, especially through groundwater recharge, and also strengthened various ecosystem services. Kato et al. (2019) studied the impacts of SLMP programs in Amhara regional. Assessment revealed that the program has: (i) helped adoption of various best management practices at the plot level; (ii) significantly increased plot-level adoption of SLM practices, particularly of soil bunds and stone terraces; (iii) contributed to improved water security for both crop and livestock production; (iv) provided households in SLM-supported learning watersheds with more access to groundwater for irrigation; and (v) increased income from livestock products, compared to households in control watersheds. The study attributed the positive impacts of SLM, and complementary interventions on livestock income, to three key factors. These are; improved water security conditions in the learning watersheds, access to better animal forage planted along SLM structures, and animal vaccination and artificial insemination services, which were part of the broader set of interventions.

However, the study only found statistically significant differences in crop yields between SLM supported learning watersheds, and non-SLM supported control watersheds, in three of the ten crops analyzed. Hence, to improve rainfed cropping and pastures, emerging evidence suggests that retaining rainfall and reducing sediment loss is not sufficient to enhance crop yields. Measures to combine rainfall infiltration with; specially improved soil nutrients (through building organic matter or using mineral fertilizers), the use of climate information and other agronomic best practices, are essential. This is supported by Adimassu et al. (2017), and further elaborated by Abera et al. (2019) (Figure 4) who demonstrated that only SWC combined with biological components (i.e. green or organic manure) result in increased yields.

Reducing soil erosion and increasing ecosystem services

A meta-analysis of ecosystem services (yield productivity, soil carbon sequestration, erosion and surface runoff reduction) in Ethiopia, was undertaken by Abera et al. (2019). This included 103 peer reviewed, published studies, representing a wide range of methodologies, approaches and scales. The analysis showed that the various AWM interventions applied in multiple locations under SLMP-1 and 2, reduced average surface runoff by between 40-90% compared to the non-intervention stage. However, large variability was observed due to the diversity of land uses, soil types and slopes. Average soil erosion rate was reduced with 50-70%, depending on type of intervention, compared to the non-intervention stage. Biological interventions, conservation agriculture practices, and controlled grazing helped enhance soil organic carbon from 20 to 140%, compared to the non-intervention stage. The study also showed that there was a slight reduction in crop productivity with the implementation of field bunds, or biological interventions, alone (Figure 4). Importantly, it concluded that so far the major emphasis of SLMP2 interventions had been on SWC structures, with less coverage and success through beneficial combinations of *in situ* SWC and biological interventions, which have the highest agricultural productivity gain. Recent evaluations and impact assessments, show that there is scope to improve efforts to intensify rainfed crop and pasture systems, within SLMP. This may be achieved through better targeted and integrated approaches to rainfall, soil, crop and agronomic management, including soil nutrient management both on farm and at the watershed scale, combined with new knowledge generation and dissemination approaches.

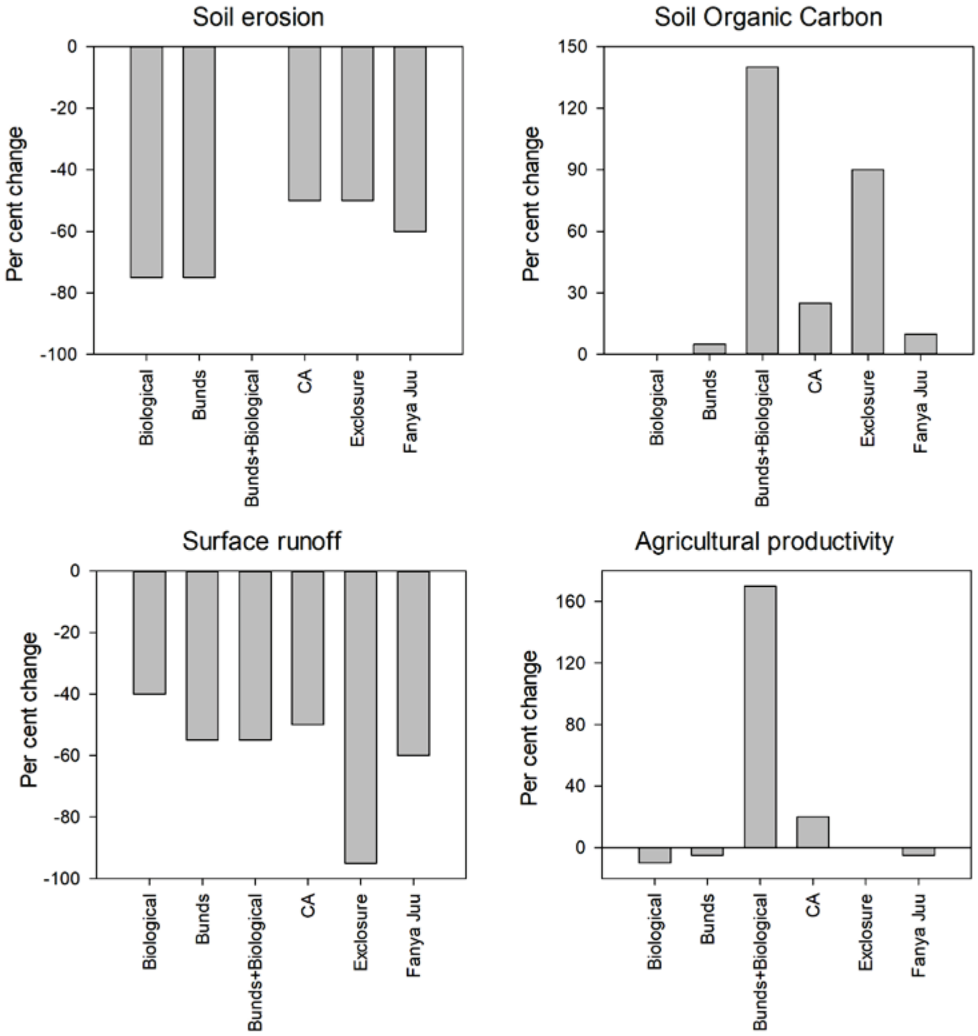

Figure 4: Magnitude of effect of different SLM interventions. The bars show the mean value of impact indicators for major AWM interventions. (Source: Abera et al., 2019)

A study of factors that influenced implementation of SLM practices in Tigray region suggested that the value of agricultural production of users of SLM was on average 77-100% higher than that of non-users (Haftu et al., 2019). Based on the comprehensive meta review, it appears that the benefits of improved land management in rainfed systems is largely related to reductions in sediment loss, and to some extent reduced runoff (i.e. increased infiltration), at the community and watershed levels. Farmers therefore need more support to enhance biological and agronomic aspects in order to realize the full yield opportunity, a key goal of the SLMP interventions.

The long term data, obtained from the GoE Central Statistics Agency, reveal that crop yields in Ethiopia have an increasing trend between 2001-02 and 2015-16. There is a sharp increase in root crops such as sweet potato and Taro (Figure 5). However, yield levels of major rainfed crops are below the potential, resulting in huge yield gaps in the rainfed system. These are estimated, for

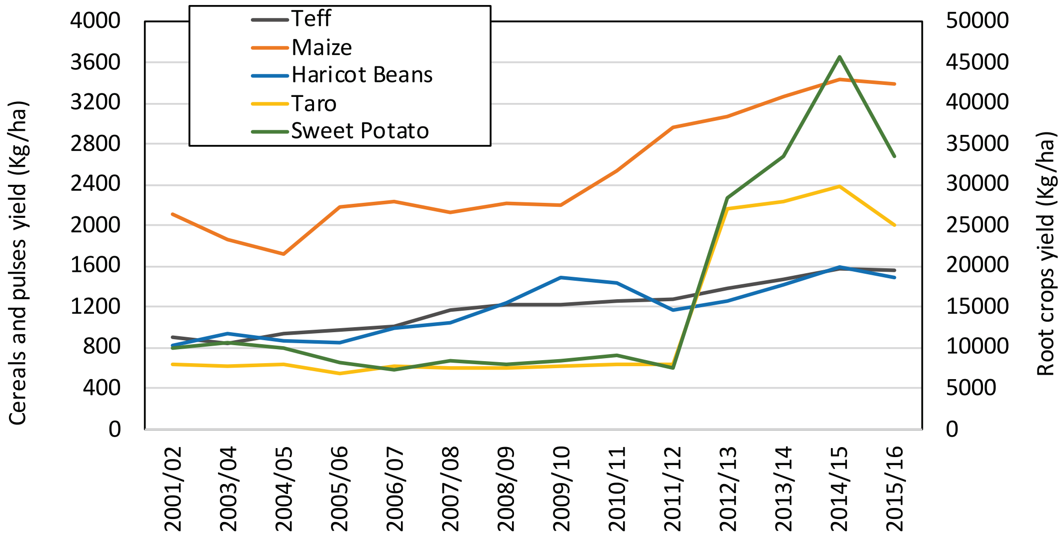

Figure 5: Change in crop yields in Ethiopia between 2001-02 and 2015-16 (Source: Central Statistical Agency, Government of Ethiopia)

example, at 1.3 t ha^{-1} for chickpea, 2.3 t ha^{-1} for common bean, 10 t ha^{-1} for maize, 3.7 t ha^{-1} for millet, 5 t ha^{-1} for sorghum and 6 t ha^{-1} for wheat (GYGA, 2020). This requires the adoption of integrated approaches to enhance rainfed systems yield levels, in order to meet the growing demand for food grains in Ethiopia. There is a strong positive relationship between public investment and supporting policies at the national level, and this needs comprehensive implementation analysis at national and regional levels.

Implementation of SLMP interventions impacted the livelihoods of participating smallholder farmers (Kato et al., 2019). Hillside plantations produced fodder and tree poles, which increased household incomes. Furthermore, land certification has motivated the community to adopt sustainable land and water management practices (Figure 6). This motivated land holders to contribute two months worth of free labor per year, on a voluntary basis, to soil and water conservation practices.

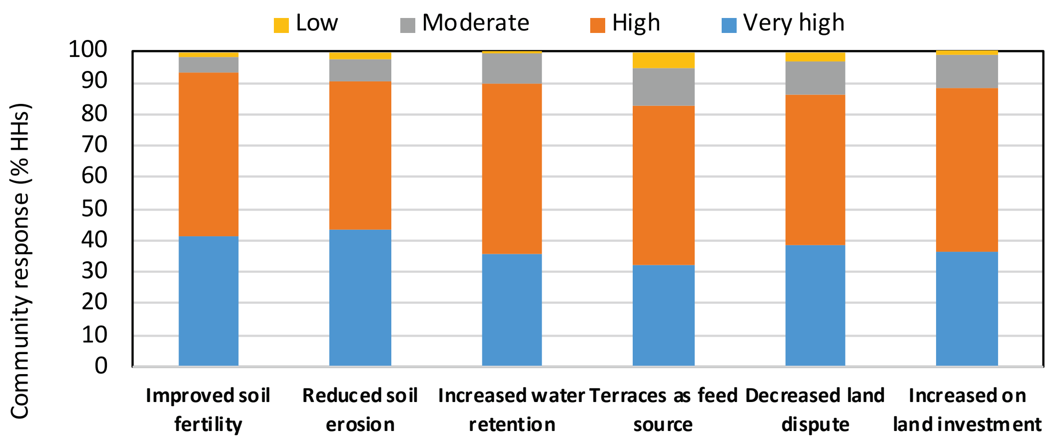

Figure 6: Community perceptions of SLMP interventions (Source: Meaza et al., 2016)

Increasing vegetative cover (feed, energy, soil fertility and reducing competition)

An impact of the long years of SLM has been increased vegetation cover, and biomass, in the exclosure area. This has increased community access to forage for livestock, that made fattening possible, and enabled beekeeping activities. Improved vegetation and biomass increased soil fertility in farm lands and reduced competition for biomass for feed, firewood and other purposes.

Economic benefits from treated areas

Experience from decades of SLM practice shows that unless rural communities gain economic benefit from restored landscapes, long-term sustainability is at risk. The German Government, GIZ and KfW collaborated with the Ethiopian Ministry of Agriculture, and relevant agricultural institutions, to implement the Sustainable Use of Rehabilitated Land for Economic Development (SURED) project (2018-2020). The aim was to add value to rehabilitated land under SLMP by increasing productivity, and improving market linkages for products and services from restored landscapes. Incomes generated from the introduction of high value crops, home gardens, beehives, community forests and grasses not only helped to increase household incomes, but also became an incentive for the implementation of more SLM practices. This is particularly important because the benefits were also distributed to landless youths and women.

4. Opportunities and synergies

Despite considerable efforts and investments by the Ethiopian government, there is still large scope for bridging yield gaps and reaching out to millions of smallholder farmers in the country. A recent study indicated that more than 75% of smallholders depend on traditional cultivars and follow conventional practices, resulting in poor land and water use efficiency (Liniger et al., 2011). There is dire need to implement various best management practices. Below are some of the key aspects to be addressed further for overall development and improved smallholder farmer livelihoods.

Developing SLM activity learning sites

There is a big opportunity to learn from the legacy of cascade projects implemented by the Ethiopian Government on SLM, aimed at increased productivity of dominant rainfed agriculture. SLMP Phase-1 introduced SLM practices to selected areas, and achieved significant progress in rehabilitating previously unproductive, degraded areas, within 45 critical watersheds in six regions. This provided benefits to rural households. SLMP-2 continued tackling poor cropland management practices, rapid depletion of vegetation cover, poor livestock grazing practices and land tenure insecurity by leveraging the successful outcomes of SLMP-1. SLMP-2 expanded its watershed restoration to cover 135 watersheds and integrated new activities targeting land productivity, deforestation, and the reduction of greenhouse gas emissions.

Another point of note is that the SLMPs, and their precursor projects, have been executed in alignment with Ethiopia's existing extension system, which makes learning easier in the process of scaling up effective interventions to all regions and districts. SLMP includes a number of watersheds with good success stories to capitalize on, and these have been used as learning sites where field days and exchange visits have been organized. It is important to further develop these learning sites with new knowledge and improved technologies, including integrated land-water-crop-livestock-tree components at watershed and landscape scales.

A cluster approach will help to achieve more benefits for all stakeholders, including; farmers, researchers, policy makers, development agencies and donors, when compared to a more sectoral approach. According to Abera et al. (2019) individual component interventions seem to be less effective, or ineffective, in creating impact and sustainability. An apropriate combination of *in situ*, *ex situ*, and biological, interventions is critical to achieving full impact potential. A number of management best practices will help to utilize available water resources more effectively. These include; the facilitation and promotion of improved quality seeds, soil quality assessments on farm and at the landscape level, all combined with local fertilizer design and advice (Tamene et al., 2018) and other agricultural inputs.

Learning sites will generate evidence on the various agro-ecological areas and help to optimize the site specific adaptation of diverse technologies, according to topography, soil type, rainfall and management practices. By applying a "seeing is believing" approach, more farmers will be able to realize the benefits of AWM by visiting these learning sites and adopting the management best practices demonstrated there.

Dissemination of the SLM outputs by strengthening extension system

Agriculture extension plays a major role in disseminating technologies and bridging knowledge gaps. In order to reach a large number of farmers with SLM technologies, it is important for the extension system to identify; local 'champion' farmers that have a demonstrated success story, and also extension workers that have shown good skills in facilitating community level implementation. The major challenge to adoption of new practices, or improved technologies, by smallholder farmers is the lack of new, location specific knowledge among farmers or extension service. Moreover, due to socio-economic challenges, lack of infrastructure, and poor communication channels, these technologies are not reaching intended stakeholders in a timely way that would enable adoption. Therefore, greater emphasis should be placed on knowledge generation and dissemination, by involving relevant stakeholders.

Monitoring, data collection and impact evaluation As Abera et al. (2019), Adimassu et al. (2019) and Kato et al. (2019) concluded, there is a lack of data for impact assessments, and for learning that would improve future efforts. This relates to several key components of impact assessments, including; biophysical, meteorological, hydrological and socio-economic parameters. For example, most of the results on uptake of practices (section 2.2-2.4) are based on field-scale data collection, which is not representative of landscape or regional scales impacts on ecosystem services such as water and sediment flows, or different vegetation cover, due to scale effects. There is no systematic, long-term monitoring of the different water balance components or analysis of upstream and downstream effects. Understanding of enhanced water resource availability, due to AWM interventions and crop intensification, could be improved to better manage water resources in local landscapes and basins. For downstream users. Also, there is poor understanding of the effects of different SLMP-1 and 2 interventions on the temporal weather scenarios of normal, dry and wet years. A systems level analysis is largely missing. It is also important to better understand the technical and economic feasibility of the program, which is necessary for scaling-up good practices. In addition to the tangible benefits generated through implementation of various interventions at the farm and watershed scales, there is also a need to capture the various ecosystem services generated by these interventions. Long-term data monitoring would help to improve understanding of both the sustainability of interventions and their impact, which is critical to informed decision-making by policy makers and donors.

Institutional strengthening and capacity development

Building partnerships between national and international research institutions, universities, non-governmental organizations, and government agencies will help to develop synergy among the various institutions involved in rural development through the programs like SLMP and PSNP. All these institutions share a common goal of achieving system level outcomes to bridge the rainfed yield gap. There is considerable knowledge available, generated by institutions such as research and academic institutes, and state universities, which needs to reach the field level if it is to play a role in achieving large scale outcomes. Non-governmental organizations and government agencies need to work closely with these knowledge generating institutes to facilitate dissemination through the appropriate channels. A strong feedback mechanism also helps knowledge generating institutions to modify technologies and approaches, based on local requirements, and the feasibility of these in different agroecological zones.

5. Way forward

The SLMPs in Ethiopia have had considerable success in contributing to the intensification of rainfed systems for millions of smallholder farmers, over more than 15 years. Efforts through SLMP-1 and 2 have focused on controlling land degradation, contributing to enhanced agriculture and livestock productivity, and strengthening a number of associated field and watershed ecosystem services. Detailed analysis of the benefits and impacts are challenging to quantify, due to the lack of systematic monitoring. Current yield levels of major crops are still far from the full potential of rainfed systems, indicating a substantial opportunity to improve current resource use efficiency. This may offer opportunities to improve the efficacy of future programs. Key aspects to be considered when preparing strategies for future interventions, include:

- the need to use an integrated approach, involving soil-crop-water-tree-livestock components, from field to landscape scales, in order to realize the full benefits of rainfed systems. A thorough analysis of the anticipated impacts of climate change on different agro-ecosystems also needs to be taken into account when designing interventions, to improve sustainability and resilience. The use of climate information (including seasonal and short-range forecasts) and agro-advisories needs to be strengthened by involving competent public and private institutions.

- thorough analysis of the technical, and economic, feasibility of various interventions will help to prioritize interventions, leading to better investment decisions. This could help generate evidence on the scaling-up potential of the best management practices.

- establishing a few, select benchmarks and learning sites, with long-term data monitoring, which capture baseline hydrology, meteorology, agriculture and livestock productivity, change in land use, and socio-economic parameters, at field and landscape levels. This information would help to generate strong evidence for the likely success, or failure, of particular interventions, and also help to inform appropriate corrective measures. Success stories and case studies should be documented to foster awareness among stakeholders of the performance of the best management practices. Similarly, visits to expose diverse stakeholders to these approaches, and their outcomes, should continue to be organized. This would foster awareness, and help them to better understand the usefulness of such initiatives.

- exploring the use of state-of-the-art technologies such as GIS, remote sensing, ICT, and simulation modeling to; identify hotspots in respective regions, inform technology prioritization, map the creation of assets and infrastructures, monitor changes in land use, and to analyze impacts. Emerging and existent ICT tools offer opportunities for large scale knowledge dissemination, feedback analysis, and real time monitoring, which can support accountability and transparency.

- making efforts to reach all regions and districts of Ethiopia, by expanding beyond the project watershed approach to include a larger number of community owned watersheds, while utilizing structural alignment, coordination and M&E experiences from SLMP in the agriculture extension system.

References

Abera, W., Tamene, L, Tibebe, D., Adimassu, Z., Kassa, H., Hailu, H., Mekonnen, K., Desta, G., Summer, R., & Vercho, L. 2019. Characterizing and evaluating the impacts of national land restoration initiatives on ecosystem services in Ethiopia, Land Degradation and Development

Adimassu Z., Mekonnen K., Yirga C. & Kessler A. 2002. Effect of soil bunds on runoff, soil and nutrient losses, and crop yield in the central highlands of Ethiopia, Land Degradation and Development, https://doi.org/10.1002/ldr.2182

Adimassu, Z., Langan, S., Johnston, R., Mekuria, W. & Amede, T. 2017. Impacts of Soil and Water Conservation Practices on Crop Yield, Run-off, Soil Loss and Nutrient Loss in Ethiopia: Review and Synthesis. Environmental Management 59, 87–101 https://doi.org/10.1007/s00267-016-0776-1

Adimassu, Z., Langan, S., & Barron, J. 2018. Highlights of soil and water conservation investments in four regions of Ethiopia. Colombo, Sri Lanka: International Water Management Institute (IWMI).35p. (IWMI Working Paper 182). doi: 10.5337/2018.214

Alhamshry, A., Almaw, A., Yasuda, H., Kimura, R., & Shimizu, K. 2020. Seasonal Rainfall Variability in Ethiopia and Its Long-Term Link to Global Sea Surface Temperatures, Water 2020, 12, 55; doi:10.3390/w12010055

Amede, T. 2003. Opportunities and Challenges in Reversing Land Degradation: The Regional Experience

(In: Amede, T. (ed), 2003. Natural resource Degradation and Environmental Concerns in the Amhara National Regional State: Impact on Food Security. Ethiopian Soils Science Society. Pp. 173-183).

Amede, T., Kassa, H., Zeleke, G., Shiferaw, A., Kismu, S., & Teshome, M. 2007. Working with Communities and Building Local Institutions for Sustainable Land Management in the Ethiopian Highlands, Mountain Research and Development Vol 27 (1): 15–19

Amede, T., Gashaw, T., Legesse, G., Tamene, L., Mekonen, K., Thorne, P., & Schulz, S. 2020. Landscape positions dictating crop fertilizer responses in wheat-based farming systems of East African Highlands. Renewable Agriculture and Food Systems 1–13. https:// doi.org/10.1017/S1742170519000504

ATA (Agricultural Transformation Agency). 2019. Annual Report 2018-19, [Cited 15 Juy 2018] http://www.ata.gov.et/wp-content/uploads/2019/12/ANNUALREPORT-2011.pdf

Bezu, S. & Holden, S. 2014. Demand for second-stage land certification in Ethiopia: Evidence from household panel data, Land Use Policy vol. 41 pp. 193-205

Center for Development Research. 2019. Sustainable Land Management Project II: Borrowers report, pp 82

Central Statistics Agency. 2018. Area and production of major crops, Agricultural sample survey for 2017/18, statistical bulletin 589, Addis Ababa Ethiopia

Croppenstedt, A., Demeke, M. & Meschi, M. 2003. Technology Adoption in the Presence of Constraints: the Case of Fertilizer Demand in Ethiopia, Review of Development Economics, 7(1), pp 58-70

Haftu, E., Teklay Negash, T. & Aregay, M. 2019. Factors that influence the implementation of sustainable land management practice in by rural households in Tigray, Ethiopia. Ecological Processes, 8:14

FAO. 2019, Small family farms country factsheet, I8911EN/1/03.18

Gashaw T., Bantider A., & G/Silassie, H. 2014. Land Degradation in Ethiopia: Causes, Impacts and Rehabilitation Techniques. Journal of Environmental and Earth Science. Vol.4, No.9.

Gebrechorkos, S. H., Hülsmann, S. & Bernhofer , C. 2019. Long-term trends in rainfall and temperature using high-resolution climate datasets in east Africa, Scientific reports, Nature research, 9:11376. https://doi.org/10.1038/s41598-019-47933-8

Gebrehiwot, S.G., Seibert, J., Gärdenäs, A.I., Mellander, P. & Bishop, K. 2013. Hydrological change detection using modeling: Half a century of runoff from four rivers in the Blue Nile Basin, Water Resources Research 49(6):1-10

Gebreselassie, S., Kirui, O.K., & Mirzabaev, A. 2015. Economics of Land Degradation and Improvement in Ethiopia. Economics of Land Degradation and Improvement – A Global Assessment for Sustainable Development. pp 401-430, https://doi.org/10.1007/978-3-319-19168-3_14

Gilligan, D.O., Hoddinott, J., & Taffesse, A.S., 2009. The Impact of Ethiopia's Productive Safety Net Programme and its Linkages, The Journal of Development Studies, 45:10, 1684-1706, DOI: 10.1080/00220380902935907

GIZ. 2015. GIZ Ethiopia: Lessons and Experiences in Sustainable Land Management, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn and Eschborn, Germany, pp 236. [Cited 15 July 2018] https://wocatpedia.net/images/c/c1/Giz2015-en-lessons-experience-sustainable-land-management-Ethiopia_8.15.pdf

Gummadi, S., Rao1, K.P.C., Seid, J., Legesse, G., Kadiyala1, M.D.M., Takele, R., Amede, T. & Whitbread, A. 2017. Spatio-temporal variability and trends of precipitation and extreme rainfall events in Ethiopia in 1980–2010, Theoretical and Applied Climatology, https://doi.org/10.1007/s00704-017-2340-1

GYGA. 2020. Global Yield Gap Atlas, [Cited 15 July 2018] http://www.yieldgap.org/Ethiopia

Haileslassie, A., Peden, D., Gebreselassie, S., Amede, T., Wagnew, A. & Taddesse, G. 2009. Livestock water productivity in the Blue Nile Basin: assessment of farm scale heterogeneity. The Range land Journal 31: 213-222.

Hurni, K., Zeleke, G., Kassie, M., Tegegne, B., Kassawmar, T., Teferi, E., Moges, A., Tadesse, D., Ahmed, M., Degu, Y., Kebebew, Z., Hodel, E., Amdihun, A., Mekuriaw, A., Debele, B., Deichert, G. & Hurni, H. 2015. Economics of Land Degradation (ELD) Ethiopia Case Study. Soil Degradation and Sustainable Land Management in the Rainfed Agricultural Areas of Ethiopia: An Assessment of the Economic Implications. Report for the Economics of Land Degradation Initiative. 94 pp.

Kassawmar, T., Zeleke, G., Bantider, A., Gessesse, G.D. & Abraha, L. 2018. A synoptic land change assessment of Ethiopia's Rainfed Agricultural Area for evidence-based agricultural ecosystem management. Water and Land Resource Centre (WLRC). Biomass Carbon Stocks Assessment for Sustainable Land Management Practices in SLMP Watersheds. Addis Ababa, Ethiopia. pp 45.

Kato, E., Mekonnen, D., Tiruneh, S. & Ringler, C. 2019. Sustainable land management and its effects on water security and poverty: Evidence from a watershed intervention program in Ethiopia. IFPRI Discussion Paper 1811. Washington, DC: International Food Policy Research Institute (IFPRI). https://doi.org/10.2499/p15738coll2.133144

Liniger, H.P., Studer, R.M., Hauert, C. & Gurtner, M. 2011. Sustainable Land Management in Practice – Guidelines and Best Practices for Sub-Saharan Africa. TerrAfrica, World Overview of Conservation Approaches and Technologies (WOCAT) and Food and Agriculture Organization of the United Nations (FAO)

Meaza, H., Tsegaye, D. & Nyssen, J. 2016. Allocation of degraded hillsides to landless farmers and improved livelihoods in Tigray, Ethiopia. Norwegian Journal of Geography 70(1), 1–12

Merrey, D.J. & Gebreselassie, T. 2011. Promoting improved rainwater and land management in the Blue Nile (Abay) basin of Ethiopia. Annexes. Nairobi, Kenya, ILRI.

Nedessa, B. & Wickrema, S. 2010. Disaster Risk reduction: Experience from the MERET project in Ethiopia. In: Omamo, S.W., , Ugo, G. & Sandstrom, S. (Eds) Revolution: From Food Aid to Food Assistance, Innovations in overcoming Hunger, WFP. pp 426

Nkonya, E., Mirzabaev, A., & Braun, J.V. 2016. Economics of Land Degradation and Improvement: An Introduction and Overview. In: Nkonya, E., Mirzabaev, A., & Braun, J.V. (Eds) Economics of Land Degradation and Improvement – A Global Assessment for Sustainable Development, Springer Cham Heidelberg New York Dordrecht London, ISBN 978-3-319-19168-3 (eBook), DOI 10.1007/978-3-319-19168-3.

Rashid, S., Tefera, N., Minot, N. & Ayele, G. 2013. Fertilizer in Ethiopia: An Assessment of Policies, Value Chain, and Profitability (December 2013). IFPRI Discussion Paper 01304. [Cited 15 July 2020] https://ssrn.com/abstract=2373214

Schmidt, E., & Tadesse, F. 2019. The impact of sustainable land management on household crop production in the Blue Nile Basin, Ethiopia. Land Degradation and Development 30 :777–787. https://doi.org/10.1002/ldr.3266

Shiferaw, B. & Holden, S.T. 1999. Soil Erosion and Smallholders' Conservation Decisions in the Highlands of Ethiopia. World Development, 27, 739-752. http://dx.doi.org/10.1016/S0305-750X(98)00159-4

Tadesse G. 2001. Land degradation: a challenge to Ethiopia. Environmental Management, 27: 815-824

Tadesse, M. 2014. Fertilizer adoption, credit access, and safety nets in rural Ethiopia, Agricultural Finance Review, Vol. 74 No. 3, pp. 290-310. https://doi.org/10.1108/AFR-09-2012-0049

Tamene D, Anbessa B, Legesse TA, Dereje G. 2018. Refining Fertilizer Rate Recommendation for Maize Production Systems in Assosa, North Western Ethiopia. Adv Tech Biol Med 6: 253. doi:10.4172/2379-1764.1000253

Tongul, H. & Hobson, M. 2013. Scaling up an integrated watershed management approach through social protection programmes in Ethiopia: the MERET and PSNP schemes. Hunger, Nutrition, Climate Justice, 2013, A New Dialogue: Putting People at the Heart of Global Development, 15-16 April 2016, Dublin Ireland.

Water and Land Resource Centre. 2018. Developing and managing the knowledge base for the natural resource and sustainable land management in Ethiopia, Biomass carbon assessment for sustainable land management Practices in SLMP Watersheds, Vol.VI-A, PP 45

Welteji, D., Mohammed, K. & Hussein, K. 2017. The contribution of Productive Safety Net Program for food security of the rural households in the case of Bale Zone, Southeast Ethiopia. Agriculture and Food Security 6 (53). https://doi.org/10.1186/s40066-017-0126-4

World Bank. 2019. Sustainable Land Management Project, Implementation Completion and Results Report, World Bank Report. [Cited 15 July 2020] http://documents1.worldbank.org/curated/en/470921571491240529/pdf/Ethiopia-Sustainable-Land-Management-Project.pdf

World Bank. 2020. Ethiopia—Sustainable Land Management Project I and II. Independent Evaluation Group, Project Performance Assessment Report 153559. Washington, DC: World Bank.

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