Synthesis Report

Sustainable Land Management in Western Kenya: *An Analysis of Project-Based Interventions*

Edited by John Mburu and Serah Kiragu-Wissler

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Table of Contents

List of Acronyms

AEZ .... Agro-Ecological Zone
AGRA ....Alliance for a Green Revolution in Africa
ASDS ....Agricultural Sector Development Strategy
BMZ ....Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung – Federal Ministry for Economic Cooperation and Development
BNF ....Biological Nitrogen Fixation
CA-SARD ....Conservation Agriculture for Sustainable Agriculture and Rural Development
CBO.....................Community-Based Organization
CDM....................Clean Development Mechanism
CGIAR ....Consultative Group for International Agricultural Research
CIG ....Common Interest Groups
CIMMYT.............Centro Internacional de Mejoramiento de Maíz y Trigo - International Maize and Wheat Improvement Centre
DAP.....................Diammonium Phosphate
DFID ....Department for International Development
FADCs ....Focal Area Development Committees
FFS ....Farmer Field School
FGD(s) ....Focus Group Discussion(s)
FIST.....................Farmer Investment in *Striga* Technologies
FORMAT.............Forum for Organic Resource Management and Agricultural Technologies
GDP.....................Gross Domestic Product
GHG ....Green House Gases
GIS ....Geographical Information Systems
GIZ ....Deutsche Gesellschaft für Internationale Zusammenarbeit (German Development Cooperation)
IASS ....Institute for Advanced Sustainability Studies
ICIPE...................International Centre of Insect Physiology and Ecology
ICRAF ....World Agroforestry Centre
IFAD....................International Fund for Agriculture and Development
IITA ....International Institute of Tropical Agriculture
ILRI ....International Livestock Research Institute
KACE...................Kenya Agricultural Commodity Exchange
KACP...................Kenya Agricultural Carbon Project
KALRO................Kenya Agricultural and Livestock Research Organization
KAPAP ....Kenya Agricultural Productivity and Agribusiness Project
KEFRI..................Kenya Forestry Research Institute
KNBS...................Kenya National Bureau of Statistics
M&E ....Monitoring and Evaluation
MIS ....Management Information Systems
MMUST ....Masinde Muliro University of Science and Technology
MOA ....Ministry of Agriculture
N2Africa..............Nitrogen to Africa
NALEP ....National Agricultural Extension Project
NAP.....................National Adaptation Plan
NEMA ....National Environment Management Authority
NPK.....................Nitrogen Phosphorus and Potassium
NRSP...................Natural Resource Systems Programme
NSWCP ....National Soil and Water Conservation Programme
SALM ....Sustainable Agricultural Land Management
SIDA ....Swedish International Development Cooperation Agency
SIMLESA.............Sustainable Intensification of Maize-Legume Cropping System in East and Southern Africa
SLM ....Sustainable Land Management
SRI.......................Strengthening Rural Institutions
STEP....................*Striga* Technology Extension Project
VSLA ....Village Savings and Loans Association

Abstract

This study was commissioned by the Institute for Advanced Sustainability Studies (IASS) in Potsdam, Germany with the aim of understanding the past successes and constraints in promoting sustainable land management (SLM) technologies in western Kenya. The study applied two key methodological approaches: desk review of the various projects that had implemented/were implementing SLM technologies, and a participatory approach to primary data collection from stakeholders (including farmers) involved in the design and implementation of the projects. The in-depth analysis was done only with ten projects that were selected from a group of 60 using diverse criteria: the location of the project, duration of the project implementation, implementing agencies, funding agencies and project budget. Focus was placed on three counties – Bungoma, Kakamega, and Siaya in western Kenya. Six themes were applied during the analysis of the projects. These include general project description, scoping and targeting, SLM technologies promoted, approaches applied in promoting SLM technologies, analysis of the enabling environment for SLM technology adoption, and project outcomes and evaluation. Baseline surveys and needs assessment surveys emerge as the most commonly used methods for determining the SLM technologies promoted by different projects.

The most common SLM technologies promoted were agroforestry, integrated soil fertility management, planting of leguminous crops, conservation agriculture, and crop rotation. Several approaches were used across different projects as outreach strategies to farmers. The use of demonstration plots, field days, and farmer field schools (FFS) emerged as the most preferred outreach strategies. Classroom model-like training was the least preferred, because it was deemed to be tiresome, boring, and monotonous. Other outreach strategies employed included the use of media, learning tours/exchange visits, and focal point persons/community project facilitators. NALEP stood out distinctively as the only project that systematically attempted to reach vulnerable farming households by stratifying households to identify their differentiated needs by using the Participatory Analysis of Poverty and Livelihood Dynamics tool (PAPOLD). Its upscaling was, however, hindered by the heavy financial investment required in an area of focus.

The most predominant enabling environment that emerged across all the projects is the organisation of farmers into farmer groups, in the form of community-based organisations, common interest groups, cooperatives, or cluster farmers. These groups were avenues for the provision of extension services on SLM technologies. Project implementers used groups to enable farmers to access input and output markets and credit through linkages to formal and informal financial institutions.

Project reports showed that adopting SLM technologies has positive impacts. These include improved soil fertility and increased crop yields. In most projects, the reports indicated adoption rates above 50% during the project implementation phase. However, the adoption rates slowed down after the projects ended mainly due to the collapse of the groups. Farmers also indicated that they could not afford SLM inputs at market prices.

Several constraints were identified as hindering the adoption of SLM technologies during and after the lifespan of the projects. These include: the lack of a well-organised extension service and delivery strategies, inadequate investment in building the capacity of farmer groups, poorly structured monitoring and evaluation systems, and the lack of clearly laid out exit strategies. A number of policy recommendations were derived based on these constraints and other themes. It is expected that these recommendations will support the future upscaling of SLM technologies in Kenya.

1. Introduction

The agriculture sector is acknowledged as the mainstay of Kenyan economy and the largest contributor to the country's gross domestic product (GDP). It is currently contributing about 26% of GDP (2015 figures). The sector's growth has also been on an upward trend registering 5.6% in 2015 compared to 3.4% in 2014 (KNBS, 2016). Besides being important in employment creation, income generation and creation of wealth, the sector contributes to enhancement of food and nutritional security of the people through direct provisioning of food (ASDS, 2010; Economic Review of Agriculture, 2015). However, even with the high contribution to the GDP, the country is not food sufficient and relies on formal and informal food imports to supplement local production. This is particularly so with the grains (mainly maize) and pulses.

Land degradation is a major threat to agricultural productivity in Kenya. It is caused by unsustainable anthropogenic activities as well as natural occurrences such as droughts and flooding. Loss of soil fertility is the most significant manifestation of land degradation in the country. This loss emanates mainly from soil degradation through erosion by wind and water, soil compaction, reduced organic matter, acidification, salinisation (especially in irrigation zones), and soil nutrient mining (from continuous cultivation without sufficient nutrient replenishment). Other processes of land degradation affecting Kenya include rangeland degradation, deforestation and desertification. Land degradation is more pronounced in the arid and semi-arid regions of eastern and north eastern parts of Kenya. Low rainfall and prolonged dry spells make the regions vulnerable to soil erosion (Muchena, 2008).

Although western Kenya has sufficient rainfall, poor soils with low levels of phosphorous, nitrogen and potassium are a major constraint to agricultural productivity. Soil erosion by water, mainly sheet erosion, is a common form of land degradation affecting areas of Lower Yala and Lower Nzoia in Siaya county, as well as Middle Yala in Kakamega County (Boye et al. 2008). Soil acidity is also a formidable challenge. It is estimated that acid soils cover approximately 13% of the Kenya land area, mainly distributed on the highlands east of Rift Valley and western Kenya regions and over half a million ha of maize growing areas (Kanyanjua et al. 2002). The witchweed (*striga* spp.) a parasitic weed is another common land degradation challenge in western Kenya. It often occurs when soil N levels are low and is often used as a visual indicator of low soil fertility. Larsson (2012) notes that farming fields with high pH have more *striga* seeds present than those with low pH. Western Kenya is also one of the highly populated regions in the country resulting in increased pressure on land and fragmentation into smaller units. This, coupled with farm practices such as mono cropping of cereals and sugarcane without use of fallow, exacerbates the land degradation problem. Together, these factors of land degradation synergise to lower crop and pasture productivity and often result to food insecurity.

Sustainable Land Management (SLM) has been identified as one of the key strategies of using land to meet the changing human needs, i.e. agriculture, forestry and conservation while ensuring long-term socioeconomic and ecological functions of land. SLM plays a critical role in ensuring sustainable food production through its role in soil fertility improvement, biomass addition to the soil, conservation of soil and water, and maintaining minimal disturbance to soil especially when conservation agriculture is practised. This in turn translates to better plant nutrients, improved water retention capacity and a better soil structure. In combination with other factors such as use of high quality, high yielding seed varieties and fertiliser, higher yields and greater resilience to vagaries of climate change can be achieved. This then ultimately contributes to enhancement of food security.

Past experiences in the implementation of SLM technologies show that interventions such as water harvesting structures, crop rotations, integrated pest and disease management, and the use of quality seeds have yielded good results. Also most of the interventions have been tailored to serve as climate change adaptation measures that increase carbon sequestration as well as organic matter content in the soils. Thus farmers not only have an opportunity to increase crop and pasture productivity but also to benefit from resilience to climate change.

SLM technologies have in recent years been a focus of the Government of Kenya and numerous development partners, due to their potential to minimise degradation, rehabilitate degraded lands and increase food production. The German Development Cooperation - GIZ, is currently implementing a programme on "Soil Protection and Rehabilitation for Food Security" in five countries – Benin, Burkina Faso, Ethiopia, India and Kenya. In Kenya, the project is being implemented in three counties in western Kenya - Bungoma, Kakamega and Siaya. The programme is part of the German Ministry for Economic Cooperation and Development (BMZ) Special Initiative "One World, No Hunger". The Institute for Advanced Sustainability Studies – Potsdam (IASS) is tasked to support this program through accompanying research that identifies the barriers and enabling conditions that constrain or support smallholder farmers to practice SLM. In particular, the accompanying research seeks to identify entry points and processes through which the known challenges to sustainable land management may be overcome in the respective local contexts. In accordance with the trans-disciplinary approach pursued by IASS, the accompanying research is implemented in close cooperation with knowledge holders and practitioners from a variety of sectors starting with farmers affected by land degradation and extension service agents who support them.

As a starting point, IASS sought to establish a comprehensive baseline for understanding of past successes, constraints and failures in promoting SLM in western Kenya with the aim of identifying lessons learned and obstacles encountered in the past. The baseline aimed to provide a robust knowledge foundation before moving towards trans-disciplinary research and implementation activities. Four questions guided the baseline study, namely:

i) How did past SLM projects select SLM technologies and beneficiary farmers?

ii) What approaches did the projects deploy to reach beneficiary farmers?

iii) Beyond SLM technologies promotion, to what extent did the projects address and improve social, economic or institutional enabling conditions for the adoption of SLM?

iv) To what extent did the projects succeed in achieving lasting adoption of SLM technologies?

These four questions were addressed in all the three counties in western Kenya and appropriate recommendations that can support future upscaling SLM technologies developed. The operationalisation of the study was led by a team from Masinde Muliro University of Science and Technology (MMUST).

2. Methodology

2.1 Data collection methods

The baseline study had its focus on SLM projects implemented in western Kenya, specifically in Kakamega, Bungoma and Siaya Counties. The criteria informing selection of the projects were i) at least one year of implementation period, ii) projects implemented after 1994, and iii) project of at least USD 100,000 budget. The baseline study was done in a span of about nine months.

A participatory qualitative approach was used to elicit most of the data. Quantitative data was mainly collected from the ten projects that were analysed in detail. Both data types were collected from primary and secondary sources.

A detailed desk review of the projects that have been promoting SLM technologies in western Kenya was conducted. Literature materials for this review were gathered from the internet and project documents from funding and implementing organisations. Information captured during this review included the location of the project, duration of the project implementation period, implementing agencies, funding agencies and project budget. The study team worked closely with IASS in order to gather all the relevant materials for the study and decide appropriately on the number and particular projects to be analysed in detail.

The desk review informed the structure of the checklist of issues which were used for conducting key informant interviews (with farmers, project designers, project implementers and implementing partners such as the government extension staff) and focus group discussions (FGDs). The latter were all-inclusive as gender, resource endowment, and vulnerability dimensions were taken care of and particularly when selecting interview participants.

Photo 1: A focus group discussion on NALEP in Kakamega County. ©William Onura

2.2 Number of projects selected for inventory and analysis

2.2.1 Summary of projects

A total of 62 SLM projects were obtained through a detailed desk review. After review and consideration of the assignment objectives, a list of 20 projects was generated (see Appendix). This list was further revised and a total of ten projects were selected for in-depth analysis (Table 1).

2.2.2 Themes analysed

The study analysed the projects according to the following themes:

i. ***General description of projects*** - provides the general information of the project, including objectives, timeframe, implementers, locations, funding partners, etc.

ii. ***Process of scoping and targeting*** - describes what the project promoted including the core activities and community groups being targeted.

iii. ***SLM technologies*** - describes SLM technologies promoted by each project.

iv. ***Approaches to promoting SLM technologies*** - explains approaches used to enhance promotion of SLM technologies. These include outreach strategies employed by the various projects.

v. ***Enabling conditions for SLM technologies*** - Analyses the "beyond the farm" factors or enabling environment that enhanced or encouraged adoption of SLM technologies.

vi. ***Project outcomes and evaluation*** - describes project outputs and outcomes, and the evaluation and monitoring (M&E) activities.

Table 1: SLM projects selected for in-depth analysis

No.	Name of the project	Overall objective	Counties
1	Kenya Agricultural Carbon Project (KACP)	Facilitate small-scale farmers in western Kenya access carbon markets and receive carbon revenues through adoption of SALM technologies that contribute to mitigation of greenhouse gases (GHGs)	-Bungoma -Kisumu -Siaya
2	*Striga* Technology Extension Project (STEP)	Deploy recently developed *striga* management technologies on severely infested farms in western Kenya	-Kakamega -Siaya (Sega and Ugunja) -Bungoma (Bumula and Malakisi)
3	National Agriculture and Livestock Extension Project (NALEP)	Promote demand-driven and pluralistic extension services to an estimated 5 million farmers, pastoralists and fisher-folk households in all 600 divisions in Kenya	- All counties in Kenya
4	Sustainable Intensification of Maize-Legume Cropping Systems in East and Southern Africa (SIMLESA)	Improve farm-level food security and productivity in the context of climate risk and change through development of more resilient profitable and sustainable farming systems that overcome food insecurity for significant numbers of families in Eastern and Southern Africa	-Bungoma (Kaduyi and Buluma) - Siaya (Liganwa and Karemo)
5	Kenya Agricultural Productivity and Agribusiness Project (KAPAP)	Empower public and private players in the agricultural sector along agricultural commodity value chains to plan, design and deliver agribusiness services aimed at value addition and linking producers to inputs and output markets	-Kakamega (Butere/Mumias) -Siaya (Ugenya)
6	Linking Soil Fertility and Improved Cropping Strategies to Development Interventions	Improve livelihoods of farmers in western Kenya by expanding their options for resource and crop management and enhancing their capacity to make relevant management decisions	-Siaya, Vihiga
7	Putting Nitrogen Fixation to Work for Smallholder Farmers in Africa (N2Africa)	Putting nitrogen fixation to work for smallholder farmers growing legume crops in Africa while working closely with national systems to institutionalise legume expertise	-Kakamega (Butere, Shinyalu, Mumias) -Bungoma -Siaya
8	Strengthening Rural Institutions (SRI) -Enabling Rural Transformation and Grassroots Institutional Building for Sustainable Land Management and Increased Incomes and Food Security Project	Foster support for variants of grassroots organisations to meaningfully participate in governance processes where their livelihoods and well-being, and the environment, are at stake, with the main purpose of developing a model for strengthening grassroot institutions for effective engagement in none policy processes that enable poor rural households to aggregate, mobilise, and access rural services	-Bungoma -Embu
9	Conservation Agriculture for Sustainable Agriculture and Rural Development (CA-SARD)	Improve food security and rural livelihoods of small and medium-scale farmers in Kenya and Tanzania by promoting Conservation Agriculture	-Bungoma -Siaya
10	Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya Project	Scale up the use of lime and other soil acidity management technologies in order to improve soil health on smallholder farms resulting in increased crop productivity and incomes of smallholder farmers of western Kenya	-Kakamega -Siaya

2.3 Limitations and difficulties in data collection

A number of limitations and difficulties were experienced during data collection due to the nature of data that was needed from the projects. First the accuracy of the data collected from project participants may be questionable as the recall period was too long, in some cases more than ten years. Also, it would be difficult for the study team to ensure that interviews were conducted only with participants who were there from the onset of the project. This is because key persons had left the project areas and especially due to politically instigated disturbances as well as the fact that the local farmers may not be able to give the actual date of project commencement. Further, some of the projects do not keep records after they have been phased out.

Secondly, most of these projects took place in the same region and had a number of similar SLM technologies. Thus there was a likelihood of duplication of efforts by project implementers. Also some of the participants may have been involved in more than one project. Therefore the consultant has to be careful that information given on a particular project is not from another one, a problem that is difficult to avoid. With some projects lacking a well-structured monitoring and evaluation system, information collected from secondary and desk review materials may also lack accuracy. Similarly, there might have been difficulties of attribution of outputs to particular projects since different projects were promoting similar SLM technologies. For instance NALEP could target all the farmers who were also being targeted by the other smaller projects.

2.4 Brief description of the analysed projects

2.4.1 Kenya Agricultural Carbon Project (KACP)

The Kenya Agricultural Carbon Project (KACP) is being implemented in Bungoma, Kisumu and Siaya Counties of western Kenya with an overall objective of facilitating small-scale farmers access the carbon market and receive carbon revenues through the adoption of SALM technologies that contribute to the mitigation of greenhouse gases. The implementers of the project include Vi Agroforestry as the lead implementing partner, National Environmental Management Authority (NEMA), Provincial administration through chiefs, Kenya Forest Research Institute (KEFRI) and Syngenta Kenya. Funding is provided by Foundation ViPlanterartrad, the Swedish International Development Agency (SIDA) and World Bank Bio carbon Fund. The project has two phases running from 2009-2017 and 2018-2030.

The core activities of the project include enrolment and sensitisation about the project to the farmers, mapping of the farms using GPS coordinates and carbon measurements through a Clean Development Mechanism (CDM) methodology. The project has been working closely with MOA extension officers, CBOs, cooperative societies, CIGs and individual farmers. The main SLM technologies promoted include crop residue management, planting of woody perennials, pile composting and compost use and crop rotation.

Several approaches in promoting SLM technologies are being used including demand-driven extension services and training, on-farm demonstrations, learning tours, workshops, newsletters, working with disadvantaged groups and motivating farmers through payments of bonuses and providing seedlings free of charge or at subsidised rates. The main enabling conditions for SLM technologies adoption in the KACP project include support for access to credit for farm investment, farmer organisation for collective bargaining and farm enterprise development component.

On project achievements, half (30,000 farmers) of the target population has been reached with innovations such as village savings and loans being adopted. Thus the adoption rate is about 50%. Monitoring is continuously done by the Permanent Farm Monitoring staff and Farmer Group Monitoring and GPS tracking of the farms.

2.4.2 Striga Technology Extension Project (STEP)

This project focused on disseminating *striga* management technologies on severely infested farms in Siaya, Kakamega and Bungoma Counties of Western Kenya. This was after the realisation that *striga* had colonised over 217,000 ha of western Kenya cropland resulting in maize losses of 182,227

Photo 2: Heap Composting in Bungoma. ©William Onura

tonnes per year valued at almost $60 million per year, contributing to increased land degradation and food insecurity among households. It was implemented jointly by Forum for Organic Resource Management and Agricultural Technologies (FORMAT) as the lead with technical support from ICIPE, KEFRI and Maseno University, and was funded by African Agricultural Technology Foundation (AATF). It had a life span of 6 years running from 2006 to 2012.

The core activity of the project was promoting, educating and disseminating SLM technologies that would help in the eradication of *striga* weed among the 24,400 farms targeted by the project. This was done by targeting individual farmers, farmer groups, CIGs and CBOs. The main SLM technologies promoted included use of leguminous crops, Maize-*Desmodium* intercrop, crop rotation and inorganic fertiliser i.e. pre-packs containing NPK, DAP and Rock Phosphate.

Approaches employed in promoting the adoption of these technologies include use of media such as posters, TV and radio, field demonstrations, workshops, special packages such as STEP and Farmer Investment in *Striga* Technologies (FIST) packages. Some of the enabling conditions in this project included providing support to the input suppliers by creating linkages with the input suppliers to the local banks for access to credit and formation of input dealer networks, strengthening linkages of farmer associations with other actors who provide information, technologies, input and output markets. The project aimed to deliver SLM technologies to 50,000 affected households in western Kenya. A number of positive outcomes reported include improved maize yields, reduced soil erosion, and improved soil fertility.

2.4.3 National Agriculture and Livestock Extension Project (NALEP)

NALEP's main objective was to promote the socioeconomic development of the agricultural sector while at the same time contributing towards the national priority of poverty eradication. Different national development components formed the project including livestock and crop development, home economics, agribusiness, environmental concerns and land development. The project was implemented by the Ministry of Agriculture and funded by the Swedish International Development Agency (SIDA). It had three phases running from the year 2000–2004, 2004–2008 and 2008–2010.

The core activity of NALEP was the dissemination of SLM technologies and building farmers' capacity for value addition and processing through agricultural extension services employing both supply-driven and demand-driven extension delivery methods. Nationally, the project initiative led to the formation of over 70,000 common interest groups (CIGs), with a total membership of approximately 150,000 individual farmers. Other participants in the project include school going kids, churches and youth groups. The main SLM technologies promoted included on-farm rainwater harvesting, conservation agriculture, *fanya juu* terraces, composting and use of farmyard manure and cultivation of leguminous crops.

Approaches employed in promoting the SLM technologies were community public meetings, trainings and on-farm demonstrations, field days, farmer groups and field visits. Stakeholder forums and Focal Area Development Committees (FADCs) at the local level provided an enabling environment during the project implementation and monitoring. By the end of the project, it was estimated that more than 70% of the farmers practised farming as a business and not merely for subsistence.

2.4.4 Sustainable Intensification of Maize- Legume Cropping Systems in East and Southern Africa (SIMLESA)

SIMLESA project has the objective of improving farm-level food security and productivity in the context of climate risk and climate change through development of more resilient, profitable and sustainable farming systems. It is being implemented in five African countries including Kenya, Ethiopia, Malawi, Tanzania and Mozambique. In Kenya it is specifically implemented in Bungoma and Siaya Counties. The project is funded by CGIAR and being implemented by CIMMYT. Kenya Agricultural Livestock Research Organization (KALRO) is the main implementing partner. The project has two phases running from 2010 to 2014 and 2014 to 2018.

Photo 3: Napier grass strips on bench terraces in Kakamega County. ©Serah Kiragu-Wissler

In the promotion of SLM technologies, a cluster approach was used – farmers in a cluster would serve as the focal points for training. The main SLM technologies promoted were conservation agriculture comprising of zero/ minimum tillage, year round soil surface cover and diversified crop rotation and legume cereal intercropping. Approaches employed in disseminating information on the SLM technologies were experimental fields, demonstration plots, extension services provision by area government extension officers, workshops, field days and innovation platforms. The enabling conditions provided by the project included farmer organisations that helped access to markets and access to credit through table banking[1]. The project's monitoring and evaluation results showed that CA-based maize-legume intercropping systems were relevant interventions in to reducing farmers' vulnerability to food insecurity.

2.4.5 Kenya Agricultural Productivity and Agribusiness Project (KAPAP)

KAPAP's main objective was to empower public and private players in the agricultural sector along agricultural commodity value chains to plan, design and deliver agribusiness services aimed at value addition and linking producers to inputs and output markets. The project targeted twenty regions in Kenya. In western Kenya it was implemented in Kakamega and Siaya Counties. The main implementing agency was the Ministry of Agriculture with funding from the World Bank. It had a life span of five years starting from 2008 to 2014.

The core activity of the project was enhancing initiatives aimed at informing reforms for improving the performance of agricultural sector thereby creating of an enabling environment for the adoption of SLM technologies. This was achieved through formation of farmer groups which when combined formed common interest groups (CIGs) at the location level. At the divisional level, the CIGs formed cooperatives. Some of the value chain commodities promoted included local vegetables, aquaculture, dairy, apiculture, agroforestry, grains and poultry production. SLM technologies promoted included planting of soya beans, use of farm yard manure from dairy farming, water conservation and soil fertility management. Approaches used in the dissemination of information of the value chain commodities and SLM technologies include demonstration plots, classroom model training and farmer to farmer visits.

There were several enabling conditions that favoured the implementation of this project with farmer organisation being the most outstanding. Through these organisations farmers were linked to lending institutions such as banks for ease of access to credit. Farmers kept records as part of the monitoring and evaluation system. A project Management Information System (MIS) was the key monitoring and evaluation tool. The project had positive outcomes such as increased incomes for all enterprises with maize and poultry being the best performers.

2.4.6 Linking Soil Fertility and Improved Cropping Strategies to Development Interventions

This project was implemented with an objective of improving livelihoods of farmers in western Kenya. This was to be achieved through expansion of farmers' options for resource and crop management and enhancing their capacity to make relevant management decisions. It aimed to promote an appropriate balance between organic and inorganic production technologies and to encourage farmers to select crops on the basis of their performance in terms of both financial and soil fertility indicators. Similarly, the project sought to explore and develop marketing channels to support production of crops that are well suited to conditions of the western Kenya highlands and ensuring adequate provision of high quality seed of priority crops and varieties. It was implemented by Kenya Forestry Research Institute in partnership with ICRAF and Imperial College, London, with funding from UK Department of International Development (DFID) and Natural Resource Systems Programmes (NRSP). The project had a lifespan of six years from 1999 to 2004.

The core activity of the project was to facilitate farmers' access to friendly credits in form of farm inputs mostly improved seeds and fertiliser. This was achieved by organising farmers into farmer groups though credit was given to individual farmers. The main SLM technologies promoted included terracing, agroforestry, crop rotation, use of grass strips and legumes such as mild crotalaria. The main outreach strategies employed were demonstration plots, field

1 Table banking is a group funding strategy where members of a particular group meet once every month, place their savings, loan repayments and other contributions on the table then borrow immediately either as long term or short term loans to one or a number of interested members

days, training and farmer to farmer visits. Access to credit for purchase of inputs was the main enabling condition in the project. Collective bargaining power and market access were also promoted by the project. The project had a positive outcome on livelihoods. Over 1000 smallholder farmers benefited from the credit advanced to them.

2.4.7 N2Africa: Putting Nitrogen Fixation to Work for Smallholder Farmers in Africa

N2Africa is a large-scale project being implemented across African countries. Its main objective is to increase inputs of atmospheric nitrogen from biological nitrogen fixation (BNF) through grain legume thereby improving crop and livestock productivity, human nutrition and farm income while enhancing soil health. Kenya falls under the Tier 1 countries in which project implementation is in its second phase. The main aim of this phase is disseminating the outcomes of the first phase through co-funded dissemination activities. The project covers western Kenya from Migori in the south to Teso in the north and includes lowlands of the Lake Victoria Basin and the lower highlands. The project is funded by Bill and Melinda Gates Foundation. It has two phases of five years each, starting from 2009-2018. The leading implementing partner is Wageningen University with support from International Institute of Tropical Agriculture (IITA) and International Livestock Research Institute (ILRI).

The SLM technologies being promoted are growing of tropical legumes, climbing beans and agroforestry. The promotion of SLM technologies has been achieved through use of existing farmer groups being supported by other projects in the implementation regions. Very specific approaches employed in promotion of SLM technologies include a three tiers approach that involves increasing household production and consumption, and community level grouping of project activities. Other outreach methods include farmer to farmer extension, trainings, demonstrations and use of media.

The main enabling environment activities in the project include strengthening farmer organisations, training of lead farmers to address the problem of limited agricultural extension officers, establishment of cottage industries, provisioning of credit facilities and marketing of soya bean. From the first phase of the project, an adoption rate of about 80% to 90% had been achieved.

2.4.8 Strengthening Rural Institutions (SRI) - Enabling Rural Transformation and Grassroots Institutional Building for Sustainable Land Management and Increased Incomes and Food Security Project

The SRI project had an overall objective of supporting grass root organisations to meaningfully participate in governance processes. This was with an aim of developing a model for strengthening grass root institutions for effective engagement in policy processes that enable poor rural households to aggregate, mobilise and access rural services. SRI project was implemented by ICRAF and funded by IFAD. It had a lifespan of four years from 2011 to 2014 and was implemented in Kenya, Tanzania and Uganda. In Kenya it was implemented in Bungoma and Embu Counties.

To achieve the above objective, focal point persons were appointed from the Ministry of Livestock Development in order to reach out to the 583 rural organisations targeted. The main SLM technologies promoted were use of organic manure including animal wastes such as cow dung, crop residues such as maize stalks and green manure, mostly *Tithonia*. Planting of woody perennials and mulching were other SLM technologies that were promoted. The outreach strategies employed included farmer to farmer visits, demonstration plots, classroom model training and field days. One enabling condition evident even after the life of the project is increased access to extension services, improved access to markets for farm produce and increased sensitisation on types of credits and their accessibility. The project had a Maturity Assessment Tool that was used to evaluate outputs of grassroots organisations that helped realise positive results from the project. These outputs were in form of increased yields following the successful capacity building and creation of a participatory scenario planning platform that led to sharing of climate and market information with farmers and the County Agricultural Sector Coordination Unit.

2.4.9 Conservation Agriculture for Sustainable agriculture and Rural Development (CA-SARD)

CA-SARD project had an objective of improving food security and rural livelihoods of small and medium-scale farmers in Kenya and Tanzania by promoting conservation agriculture (CA) technologies. Project interventions were designed to address barriers to improved yield, food security and sustainable farming such as declining productivity of land, adverse effects of climate change and lack of appropriate farm tools. In Kenya it was implemented in five counties among them, Bungoma and Siaya Counties. The lead implementing agency was Ministry of Agriculture. The project partners were FAO, Africa Conservation Tillage (ACT) and farming communities. Funding was provided by the German Government. The project had three phases running from 2004-2006; 2007 to 2010; and 2011 to 2014, respectively.

The core activity of the project was to promote conservation agriculture technologies. This was achieved through establishment of farmer field schools through participatory technology development mechanisms. The SLM technologies promoted are those in line with the CA principles of minimum soil disturbance, maintenance of permanent soil cover and crop rotation. Specifically, the project promoted minimum tillage, planting of low growing leguminous crops, relay cropping and crop rotation. The outreach methods applied in the project were: farmer field schools, demonstration plots, field days and trainings. The enabling conditions for adoption of SLM technologies included facilitating access to appropriate farm tools, access to credit through table banking and access to farm inputs through collective bargaining power. The FFS were instrumental in facilitating access to these services. The project used evaluation methods such as document analysis, group and individual meetings with beneficiaries, stakeholders and key informants and field visits. One of its positive outcomes is that a total of 100 FFS were formed and about half of these had taken up the CA practices learned and acquired from the project. This translated to 50% adoption of SLM technologies that were promoted by the project.

2.4.10 Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya Project

This project was implemented with the objective of scaling up the use of lime and other soil acidity management technologies in order to improve soil health on smallholder farms. This was done with a focus on improving soil health on smallholder farms resulting in increased crop productivity and incomes of smallholder farmers in Kakamega and Siaya Counties of western Kenya. It was implemented by Kenya Agricultural and Livestock Research Organization, (KALRO) in collaboration with Moi University. It was funded by AGRA (Alliance for Green Revolution in Africa). The project had a life span of three years from 2009-2012.

The project did not make any deliberate effort in reaching out to the farmers and anyone willing to apply lime in their farm was welcomed to participate. Special interest groups were also not targeted by the project. The main SLM technologies promoted were application of lime and integrated soil fertility management such as preparation and use of compost manure. Outreach methods applied were field days, *barazas* (public gatherings), classroom teaching methods and demonstration plots. One of the project outcomes is that the soil pH was raised from 4.5 to 5.8 by the end of the project. Yields had also increased and so was the soil fertility. It was noted that the project did not undertake any enabling conditions activities that would promote or encourage the adoption of the SLM technologies. In fact it had a myriad of challenges, among them being the high cost and physical inaccessibility of lime.

3. Sustainable Land Management (SLM) Technologies

3.1 Brief overview of agricultural practices in the study area

Small-scale farming is dominant in the three counties following land fragmentation necessitated by increasing human population. The main food crops grown in these counties are maize, beans, sorghum, finger millet, groundnuts, cowpeas, cassava, potatoes, vegetables and bananas. Cash crops include sugarcane, sunflower, tobacco, coffee, tea and maize. The common livestock include shoats, cattle and poultry, which are mainly cross-breeds with indigenous or local breeds. Aquaculture is also a common agricultural practice particularly in Kakamega County which produces tilapia and cat fish as the main fish species. The county is also the main producer of coffee and tea in the study area. Sugarcane growing is more prominent in the Mumias/Butere sub-county of Kakamega.

Bungoma is well known for the production of maize which is grown from hybrid seeds. The county is ranked as the 4th largest producer of maize and beans after Trans-Nzoia, Uasin Gishu and Nakuru. Across the three study area counties maize is the staple food. It is also grown as a cash crop in Bungoma and Kakamega. Vegetables like kales, cabbage, onions and tomatoes are grown especially during the second season (Oct-Jan) as subsistence crops (Jaetzold et al., 2005).

In Siaya County, most of farmers practice subsistence crop farming on small land parcels. There are several challenges to agricultural production experienced in this county with the most common ones being over-reliance on rainfall which lead to fluctuating yield, low use of fertiliser and high quality seed varieties, high crop and livestock diseases, inadequate extension services due to high farmer-staff ratio, and poor market access due inaccurate and untimely market information.

In all the study area counties, leaving the land fallow for long periods of time has been the most common indigenous SLM technique for many decades. This was characterised by an extensive system of production especially in areas where population density is low. However, with increasing population pressure and food demand, this technique is slowly dying, giving rise to more innovative SLM technologies such as agroforestry, crop rotation and integrated soil fertility management that can be applied to ensure increased agricultural productivity as well as conservation of soil.

3.2 SLM technologies most commonly used in study areas and their selection processes

Several SLM technologies have been promoted across all the study area counties over the years. Most of the SLM projects identified have a minimum of two SLM technologies, with some having a maximum of eleven. Some of the most common SLM technologies promoted include:

i. *Agroforestry:* this involves planting of perennial trees within the farm as woodlots along farm hedges or intercropping with crops. Most tree species promoted were Grevillea spp, Moringa spp, *Sesbania sesban*, *Calliandra* spp and *Leucaena*. These trees were selected because they not only boost soil fertility through nitrogen fixation (if leguminous) but also provide fodder for livestock. Moreover, they are also used as construction materials and are a good source of fuel for domestic use. Some trees like *Sesbania* provide support when intercropped with climbing beans. Projects that promoted agroforestry included KACP, SRI project, Linking Soil Fertility and Improved Cropping Strategies to Development Interventions project, NALEP and N2Africa project.

ii. *Planting leguminous crops:* tropical legumes are the most common leguminous crops promoted. They were selected because of their soil fertility replenishing properties through nitrogen fixation, addition of organic matter to soil after decomposition and reduction of the *striga* seed bank. Low growing legumes were also promoted because of their soil cover maintenance abilities. Some of the most common legumes include soya bean, climbing beans, cow peas, groundnuts, green grams (*mung* beans), *Dolichos*, *Desmodium* and common beans. Projects promoting planting of leguminous crops include: N2Africa, Linking Soil Fertility and Improved Cropping Strategies to Development Interventions project, SRI project, CA-SARD project, KACP, SIMLESA, NALEP and STEP.

iii. *Crop rotation:* this SLM technology was promoted because it enables efficient utilisation of soil nutrients, serves to control pests and diseases and helps to diversify crop production. Some of the projects promoting crop rotation are KACP, CA-SARD, STEP, and Linking Soil Fertility and Improved Cropping Strategies to Development Interventions project.

iv. *Conservation agriculture:* Most common conservation agriculture technologies include zero/minimum tillage and use of cover crops. Planting cover crops was more preferred across the projects because there were minimal and relatively affordable input requirements compared to zero/minimum tillage. Minimum tillage required use of herbicides and certain farm implements such as jab planters and rippers which were perceived to be costly by farmers. Projects promoting conservation agriculture include SIMLESA, CA-SARD, NALEP and KACP.

v. *Integrated soil fertility management*: the technology entails preparation and use of compost manure, crop residue management, pile composting and compost, organic manure and green manure. These SLM technologies were easily adopted by farmers across most projects because the impact on production was very visible. In particular increased yield was evident in the same season of application. Projects promoting integrated soil fertility management were KAPAP, KACP, NALEP, SRI project and Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils project.

vi. *Other SLM technologies:* These include integrated crop livestock management, application of lime in acidic soils, mulching, rain water harvesting, terracing, intercropping practices such as relay cropping, maize-*desmodium* intercrop (push-pull technology) and use of inorganic fertilisers such as pre-packs (NPK, DAP, Rock phosphate) which were promoted by STEP project in an attempt to fight *striga* weed. Section 3.4 has specified the projects promoting these and other technologies.

The selection criteria for most of these SLM technologies were predetermined either through participatory approaches i.e., based on what farmers deemed as having quick returns and the conditions of the farms and soils. Baseline surveys, needs assessment surveys and crop production trends were methods applied when determining the SLM technology used in a certain area by a specific project. For instance in the Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils project, declining maize yields in western Kenya was indicative of high soil acidity. Soil tests indicated very high pH levels to support maize production and therefore a technique to balance the soil pH was required. Similarly, in the STEP project, the intensity of *striga* weed infestation in the western Kenya informed the technologies to apply. These were supposed to be effective in *striga* elimination, affordable for the farmer and provide extra benefits such as increased soil fertility through nitrogen fixation from the maize-*Desmodium* intercrop.

3.3 SLM technologies adoption rates during and after project

The proportion of farmers reached and started practising the SLM technologies can be used as an indicator of the adoption rates. Further the proportion of land covered can be used to indicate the extent or intensity of adoption of SLM technologies. However, since the data of total households or groups targeted is not available, it is difficult to calculate the actual adoption rates. Thus in some cases the adoption rates are not indicated. Instead the short term impact of adoption (e.g., increase in crop productivity) are used to give an indication that there was technology uptake.

The KACP project is still under implementation and so far has reached over 30,000 farmers (50% of those targeted) who practice woodlot perennial/tree planting on 6000 farms under 591 ha of land. Maize yields are reported to have increased from 2 bags to 20 bags per acre.

In western Kenya, the project reached 30,000 smallholder farmers in the project target area of Emuhaya, Kakamega South, Mumias and Gem districts. There were 3,421 non-project farmer participants reached through spillover effects. *Fanya juu* terraces and grass strips technologies had 60% adoption rates.

In SIMLESA project, there was 73% adoption of maize-legume intercrop, 48% crop residue retention, 26% maize-legume rotation and 21% minimum tillage. The adoption of hybrid seed varieties in the project area ranged between 38% to 41%. Conservation agriculture techniques were not adopted holistically, i.e., incorporation of the three aspects of CA (crop rotation, mulching and minimum/zero tillage) had only 3.7% of the farmers in the project.

The N2Africa project recorded an adoption rate of 80% to 90% by the end of the first phase. In the STEP project, maize yields increased from 2 to 18 bags per acre while in KAPAP project soya bean production increased threefold from 100kg to 300kg per season. The Linking Soil Fertility and Improved Cropping Strategies to Development Interventions project saw over 1,000 farmers benefit from the loans disbursed while the SRI project recorded increased maize yields from an average of 6 to 26 bags per acre.

In the CA-SARD project, a total of 100 farmer field schools (FFS) were formed with over 3000 members which was 15% beyond the project's target (10 FFS in Bungoma and 10 FFS in Siaya). About 50% of the farmers in the FFS had taken up elements of CA and an estimated 75% of them were aware of the CA benefits. Maize yields also increased from 2 to as high as 12 bags per acre. Similarly, Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya project had good adoption results. The project had 3,000 farmers reached with an increased maize production recorded from 0.5 - 1.8 tonnes per acre after lime application.

It was difficult to gauge adoption rates after the projects ended. This is because some of the projects are still being implemented and the phased out ones have not had ex post evaluations. From farmer interviews, there is evidence that technologies like crop rotation, use of crop residues, mulching and making of compost manures received high adoption levels in all study counties even after the projects ended. However adoption of some of the SLM technologies slowed down once the projects has ended. This was particularly so with technologies that were accompanied by the supply of free inputs during the project periods. For instance, adoption of agroforestry drastically slowed down when Vi Agroforestry stopped supplying free seeds and seedlings. Also, some of the groups could not survive beyond the project period due to leadership and management problems. Since the projects were using groups to reach out to individual farmers, adoption of SLM technologies could not be sustained after project implementation as the groups disintegrated. Other examples include the uptake of conservation agriculture and the use of lime. Overall, SLM technologies that demanded additional expenditure from household budget did not fare well.

3.4 Technology-specific limitations among analysed projects

As shown in Table 2, SLM technologies have specific limitations that can hinder their uptake. This report considers only the major limitations of the most common SLM technologies that were promoted by different projects.

Table 2: Technology-specific limitations among analysed projects

SLM technology	Specific limitation	Projects
Agroforestry	• Seed dormancy leading to poor germination following lost viability • Possible competition with food crops for space, sunlight, moisture and nutrients leading to reduced crop yields • Seedlings are expensive	KACP, SRI, NALEP, N2Africa and Linking Soil Fertility and Improved Cropping Strategies to Development Interventions Project
Leguminous crops	• Lack of markets for overly produced legumes such as soya bean, green gram and *Dolichos* lablab • High incidence of pests and diseases	N2Africa, SRI project, CA-SARD, KACP, SIMLESA, NALEP, STEP and Linking Soil Fertility and Improved Cropping Strategies to Development Interventions Project
Crop rotation	• Takes a lot of time to prepare the soil for new crops when rotating • Lingering pest and fungi can potentially harm the new rotated crop	KACP, CA-SARD, STEP, Linking Soil Fertility and Improved Cropping Strategies to Development Interventions Project
Conservation Agriculture	• Limited access to and acquisition of inputs and implements such as herbicides for weed control, rippers and jab planters • High cost of maintenance and repair of the implements leading to frequent grounding	SIMLESA, CA-SARD, NALEP and KACP
Integrated soil fertility management	• Labour, land and knowledge-intensive • Green manure such as *Tithonia* may pose as a competitor with other land uses that have direct economic returns	KAPAP, KACP, NALEP, SRI project and upscaling the use of agricultural lime project
Cereal-legume intercropping including *striga* control	• Certain agronomic practices like use of herbicides can be a limiting factor • Pre-packs in *striga* control rated as being expensive and labour-intensive	CA-SARD, STEP, N2Africa, KAPAP, SIMLESA
Lime application	• Inhibitive prices • Bulkiness - storage and transportation of lime is difficult • Health concerns if proper application gear is not used • Long duration to realise lime effects on yields	Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya Project
High yielding seed varieties	• Presence of adulterated (fake) seed	STEP, CA-SARD
Mulching	• High prices for seeds and fertilisers • Other competing uses of residues, e.g., animal fodder and fuel	CA-SARD, SIMLESA
Rain water harvesting	• Time-consuming and labour-intensive • Setting up the water harvesting system can be expensive • Open water holding pans can pause as health hazards	NALEP

4. Targeting of project beneficiaries

4.1 Outreach strategies and their shortcomings

Several outreach strategies have been applied in promotion of SLM technologies. The most preferred outreach strategy, as informed by the ten analysed projects, was *demonstration plots*. This is because of its practical and pragmatic nature. Farmers were able to observe, visualise and relate with different results of plots with and without SLM technologies. This outreach strategy was also demand-driven. Demonstrations were however not feasible in projects involving livestock enterprises because of the long period of time required for animals to be served and get a calf.

Farmer field schools (FFS) was another outreach strategy where farmers gathered together for training and learn of the SLM technologies. Training (classroom model teaching) was employed in most of the projects. Here farmers were taught the principles behind certain SLM technologies. This outreach strategy was the least preferred with farmers citing boredom, lack of concentration, tiring and monotony as the main reasons.

Farmer to farmer visits were also employed and deemed to be effective though the rate of success depended on the knowledge and skills acquired by the farmer/group representative and the capacity to effectively teach the rest of the groups or farmers. Further, farmer to farmer outreach strategy was limited by the high cost of organising the visits and hence only a few of the farmers or group members could benefit directly. There were also cases of resentments within groups at it was perceived that visiting opportunities were taken by group leaders. Some beneficiaries never made effort to share the knowledge they gained from the visits.

Media and broadcasting as an outreach strategy had the advantage that it could be employed in the promotion of SLM technologies in wider areas and at any time of day and night. The most common media included radio, television, posters and newsletters. This was a common strategy in STEP. However, use of posters/newsletters and TVs was ineffective because of limited literacy and coverage, respectively.

Learning tours and exchange visits were employed where farmers went as far as Mexico to learn from experiences of other farmers. The learning tours were also as near as from one farmer field school in a town to the next one. Not everyone could be sponsored for a learning tour and hence very few farmers benefited from this strategy. In most cases the leaders of farmer groups were the beneficiaries creating some sort of resentment from other farmers.

Other outreach strategies employed include *on-farm extension visits*, *workshops and farmer motivations*. Farmers could also be reached through Chief *barazas* and during engagement in innovation platforms[2].

4.2 Inclusiveness: gender, the vulnerable

Almost all the projects analysed considered gender dimensions and targeted the food insecure and resource-poor farmers during their implementation. These include widows, disabled, youth and vulnerable groups such as persons living with HIV/AIDS. NALEP was the only project that systematically attempted to stratify farming households with the aim of identifying and targeting the most poor, through a tool called PAPOLD – Participatory Analysis of Poverty and Livelihood Dynamics. Its upscaling was, however, hindered by the heavy financial investment required in an area of focus. Overall, the level of success for the projects that made efforts to address gender inequality and reaching out to vulnerable groups is difficult to establish as no ex post-project evaluations were done.

2 Innovation Platforms: Group of individuals (who often represent organizations) with different backgrounds and interests: farmers, agricultural input suppliers, traders, food processors, researchers, government officials etc. The members come together to develop a common vision and find ways to achieve their goals. Source: https://goo.gl/5cWgI1

In some cases, projects did not successfully incorporate vulnerable households mainly because of land tenure limitations. Thus there are situations where women and youth could not participate in projects without the approval of husbands or parents. For instance, the KACP project required beneficiaries to have land and its location mapped with GIS. Some husbands were reported to have refused GIS mapping because they did not want to disclose how much land they owned; and in some instances they did not allow their women to track their land. Therefore women participation was limited. In NALEP project women participation was limited by certain cultural beliefs. For instance, women could not plant trees in some areas as they believed this would cause their husbands death. Similarly, they could not practice rainwater harvesting because they are not allowed by men to climb on the roof tops.

Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya project made no deliberate effort to consider gender issues and the vulnerable in planning for its activities. This may be related to the spatial nature of interventions required to improve soil pH.

5. Enabling environment for sustainable adoption of SLM

A number of factors beyond the farm level constrained achievement of sustainable adoption of SLM technologies. These include land tenure insecurity, inadequate access to credit and markets, inadequate extension services from government and limited access to SLM inputs such as lime, CA equipment, quality seeds and tree seedlings. These enabling factors are discussed in this section.

5.1 Land tenure

Secure land tenure creates an enabling environment for farmers' participation in projects that require long-term investments in land. From the analysis of the projects, lack of secure land tenure played a big role in constraining participation and ultimately adoption of some SLM technologies. The most affected groups of people were women and widows who do not have full rights to land ownership and/or access and had to rely on their husbands or relatives' approval to use the household land. Husbands approve allocation of farming land uses across competing crops, and have higher inclination to allocate the bulk of the land to cash crops such as sugarcane or tobacco at the expense of subsistence crops like legumes mainly grown by women. Young farming households (Youth), without long-term guarantees of land ownership from parents are excluded from projects that advance SLM investments such as agroforestry trees. Such was the case with KACP which failed to loop in youth in agroforestry despite their inclusion in the project design.

5.2 Access to credit

Some the projects created an enabling environment by facilitating farmer access to credit. This was through advocacy for certain credit facilities, sensitisation of different types of credit available in the market, creating linkages to credit facilities, and creating ease of access to credit by pooling resources, e.g., through table banking where farmer groups could borrow from each other. For instance, the KACP supported access to credit for farm investments through a Village Savings and Loan Association (VSLA) design. Similarly, the innovation platform of SIMLESA assisted in the formation of table banking among farmer groups in an endeavour to access credit. The KAPAP project organised farmers into groups (CIGs and cooperatives) and linked them to local banks such as Equity Bank and Kenya Commercial Bank for ease access to credit. With the increased maize yields following the use of SLM technologies such as lime application, farmers were able to access more credit due to improved borrower portfolio.

5.3 Access to markets

Some projects facilitated farmer access to local and national output markets. The SIMLESA's innovation platform, for example, assisted farmers to collectively organise access to market for their produce. Farmers in Bungoma interacted with Kenya Agricultural Commodity Exchange (KACE) that linked them to good maize buyers. One of the three "tiers" (components) of the N2Africa project was dedicated to market linkages for excess soya produce through enrolment of private industrial processors of soya beans. Although the performance of this component did not deem overly successful, its inclusion in the project design was a significant milestone in recognition of the need to go beyond promoting farm production to supporting market access for excess farm produce.

5.4 Access to inputs

A major constraint to adoption of various SLM technologies was lack of access to inputs. The projects analysed created an enabling environment by providing inputs free of charge or at subsidised prices. These included farm implements for use in conservation agriculture, seed, seedlings and lime. The KACP project provided farmers with tree seedlings for use in their agroforestry practices. Under the Upscaling the Use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya Project, KALRO provided free lime to farmers initially and later at subsidised rates. Unfortunately free or subsidised SLM inputs did not seem to motivate adoption after closure of projects, a concern that needs critical redress in SLM project designs. Among the challenges was the inability of farmers to sustain demand for the SLM inputs and thus motivate private farm input dealers to stock them.

5.5 Support of farmer organisations

Most projects offered support to farmer groups that were established in various ways. STEP project strengthened linkages of farmer associations with other agencies and businesses that provided information, technologies, farm inputs and marketing services in support of *striga* control. Farmer groups were strengthened through value addition activities such as soya bean processing and posho mills for grinding maize into flour. There was also support, e.g. Under the SRI project, in form of empowerment and building of organisational capacity of farmer groups to enhance their collective bargaining power, pooling together of resources and procurement of farm inputs from agro-dealers at subsidised prices. Thus through farmer organisations such as CIGs project beneficiaries were empowered to collectively access both input and output markets. The KAPAP project managed to address the constraint of accessing inputs, markets and value addition in honey, dairy and groundnuts by organising farmers into groups. This resulted in increased beneficiary income by 196% and 111% in maize and poultry value chains, respectively.

5.6 Other findings/ factors supporting or constraining SLM adoption

Other factors that supported the adoption of SLM technologies include the sustainable platforms of the SRI project. The platforms had farmer educative radio programmes that through the County Agricultural Sector Coordination Unit facilitated local communities to get involved in participatory scenario planning and thus helped in the sharing of information on climate and benefits of adopting SLM technologies.

Increased access to free extension services from the Ministry of Agriculture also enhanced adoption of SLM technologies in all the study area counties. In most of the projects the extension services were demand-driven with farmers organising themselves and requesting training in certain value chains that were of greater interest to them. An example is the demand for training in poultry production in Siaya County. Other demand-driven extension needs were related to entrepreneurship, village banking and livestock management.

The factors that constrained adoption of the SLM technologies within the projects include cultural beliefs and traditional practices. There are also a good number of technology-specific limitations that have been indicted in Table 2 (Section 3.4).

6. Conclusions

6.1 Trend in adoption of SLM technologies

During project implementation, farmers seemed to embrace the SLM technologies promoted and considerably good adoption rates were achieved. Thus there have been positive results such as high fertile soils, control of *striga* weed, reduction in soil erosion and improved crop yields. In some cases maize yield increased by as much as 20 times. However continued use of SLM technologies after the life of the projects is limited. While there is a lack of post-project evaluations to provide the actual adoption rates, tendencies to abandon the SLM practices are high with most farmers citing lack of access to required farm inputs due to high prices. There is also lack of markets for sale of the extra produce realised from adoption of SLM technologies.

6.2 Main factors supporting adoption of SLM technologies

Field demonstrations, farmer field days and learning tours were very popular and were considered by farmers as effective in disseminating and exchanging knowledge on SLM technologies. Though farmer field schools were also considered effective, they were faulted for being time-consuming and imitating the classroom model of training.

Collective action was found to play a major role in supporting adoption of SLM technologies. Thus organising famers into groups facilitated faster outreach. These groups were instrumental in the dissemination of information, peer-peer learning and collective access of inputs and output markets.

6.3 Main factors constraining adoption of SLM technologies

Local demand for SLM inputs is constrained by low household incomes in western Kenya. In turn, low demand lowers motivation for local production by farmers e.g. of Caliandra and *Desmodium* seeds; and unwillingness of agro-dealers to stock SLM inputs (quality seeds, CA tools; *striga*-Resistant maize; BNF inoculum and Sympal fertilisers). The result is tapering adoption after end of promoting projects.

It was noted that giving farmers inputs free of charge or at subsidised rates did not assure continued adoption of SLM technologies. It was evident that farmers need to realise genuine value in investing in SLM. For instance, among the soya bean growing farmers the greatest motivation was observed to be income generation.

It was found that outreach strategies such as classroom model of training can constrain adoption because farmers do not like them. Much attention also need be paid to cultural barriers to adoption. Similarly, targeting of men should be enhanced since they are likely to slow down adoption if they are not directly involved.

While outreach on SLM technologies benefited from the group approach, some elements of the group approach did not always translate into adoption. Farmers who were non-group members felt excluded and did not necessarily reach out to the groups for information as was assumed. Discontentment was evident as non-group members watched from the sidelines as group members were supported with free inputs.

Farmer to farmer extension did not always perform as per design. The expectation that farmers participating in exchange tours or innovation platforms would share their knowledge and skills with other group members did not always materialise, a factor that also added discontentment in groups.

On the whole, extension services were considered insufficient. In the worst scenarios, the wrong information was unintentionally interpreted – for instance, some farmers who received free agricultural lime used it for construction.

6.4 Predominant enabling conditions across analysed projects determining uptake of SLM technologies

Three predominant enabling conditions are evident prom the projects analysed. These are: 1) access to farming credit, 2) access to input and output markets and 3) access to extension services. From the farmer organisations/ groups established in the projects, farmers have been able to access credit for farming. This is either through linkages to formal credit lending institutions such as banks or informal channels such as table banking and innovations such as Village Savings and Loan Associations.

The collective bargaining power and social capital through farmer organisations played a critical role. Farmers were able to purchase farm inputs at reduced prices through bulk procurement. Similarly, for the output markets, farmers through groups were able to access an off taker for their produce and were able to collectively bargain for good prices. In some instances farmer organisations were vocal in advocating for social/public services such as health facilities and road infrastructure.

6.5 Common pitfalls in project design and execution

Most projects tended to work with groups, either new or existing. However group dynamics and management were not given sufficient attention in most of the projects. Thus many of these groups could not sustain their marketing operations after the end of the project period. Not all members of the community can belong to the groups. The assumption that group members will in turn transmit knowledge and skills to non-members is questionable. Non-group members feel excluded and are not always willing to reach out to group members getting support from projects. Similarly, the projects had no appropriate initiatives put in place to address limitations posed by lack of access to farm inputs. Thus farmers ended up getting free inputs or at subsidised prices. This created a tendency to depend on free handouts and led to abandoning of the SLM technologies after the projects ended. Disadvantaged groups in the society were given priority in almost all the projects. However the outputs of interventions among these groups could not be well demonstrated.

In most of the projects, the M&E component was very weak. Thus it was difficult to find end-term reports of the projects. Also, local agencies did not seem to have owned the projects and therefore could not support them after funding from donors is over.

6.6 Lessons learned

There are a number of lessons that can be learned about the different approaches used by projects in targeting project beneficiaries:

i. The project's model of implementation is crucial for its success in targeting beneficiaries. The project can either target individual farmers or groups. It seems using groups not only strengthened existing farmer organisations but also led to emergence of a participatory approach in project implementation and many farmers were easily reached. But caution needs to be taken to curb a feeling of exclusion among non-group members.

ii. Giving of free inputs or at subsidised prices does not always assure long-term adoption of SLM technologies. Projects need to innovate for realistic value in investing in SLM. Link to income generation has such potential. A targeting strategy works well if it is participatory in nature. Farmers have to be involved and their views taken to account. Thus farmer demonstrations and FFS were a very successful tools for enhancing outreach

iii. Agricultural extension and advisory services is a critical cog in the exchange of knowledge on SLM technologies. Given that many SLM projects are implemented by NGOs or action research organisations, sustained and long-term provision of extension services has to be planned through local permanent institutions such as the Ministry of Agriculture.

iv. Projects that embrace enabling conditions such as access to credit for farm inputs and market access for farm produce are received by farmers with more enthusiasm. More institutionally-robust and economically viable designs are necessary to enhance uptake of SLM technologies.

7. Policy recommendations

7.1 Scoping and targeting

Almost all the projects had farmers organised into groups that enabled dissemination of the SLM technology information. It was however noted that most groups lacked capacity for good management and many collapsed as the projects ended. Some also lost trust in most initiatives such as village savings and loans associations and innovation platforms. Exclusion was perceived by non-group members. There is need for project investments in capacity building of groups in order to strengthen them and provide continued support during and beyond the life of a project. Alternative strategies to address inclusivity need to be pursued.

7.2 Choice of SLM technologies

Results showed different adoption rates for different SLM technologies. This is because some of the technologies promoted were perceived to be costly and unaffordable by the farmers or not feasible because of land tenure matters, making their sustainability questionable especially after the life of the project. Most notable was the conservation agriculture component of zero/minimum tillage that requires some good level of farm mechanisation. This implies that during project design, the SLM technology being promoted should be well thought through and baseline findings on the targeted farmers and their attributes considered. Needs assessment results should also help to indicate which SLM technologies are of great interest to farmers in given area.

7.3 Approaches to promoting SLM technologies

Different approaches were employed in the projects in an attempt to promote and disseminate information on the SLM technologies. Project implementers should be careful to choose an appropriate outreach strategy that would be most effective for a particular technology. For instance, livestock farmers would benefit more from tours and visits as demonstrations would not be feasible. Care should be taken when adopting outreach strategies such as motivations in form of bonuses or free inputs as such can easily lead to dependence tendencies and unmanageable expectations. It is important to note that demonstration plots were ranked best and most effective for most of the technologies. Application of this outreach strategy should be enhanced in future projects. However, caution needs to be taken, as demonstration plots hosted by farmers (also called model farmers) sometimes create impression that the host farmer is getting too much external support at the expense of the others. The use of radio in local dialect was found to be more suitable and effective, and particularly in participatory scenario planning. This approach could be enhanced in future to include extension messages in addition to climate and market information.

7.4 Enabling Conditions

Extension service provision was a major enabling environment that heavily influenced the adoption of SLM technologies. Most of the SLM technologies could not be adopted without proper training and dissemination of information to the farmers. In addition, sustainability of the technologies beyond the life span of the project ideally would benefit from continuous extension service provision. Therefore, considerable investments in long-term extension strategies by the national and county governments should be enhanced and prioritised.

Credit access was mostly successful during the implementation phase of the project. After the projects had ended there were declines in credit access, especially where farmer groups had collapsed. Thus besides capacity building in group dynamics, training on financial literacy could be provided so that individual farmers are more aware of how credit systems work. This would provide them with more options including being able to access credit from other sources as individuals.

Access to markets for farm produce was observed to be a constant wish for farmers. SLM projects need to provide for this demand in project designs. Partnerships with private sector for market access need to have a strong social impact orientation in order to accommodate and/or address the challenges facing farmers such as intermittent supplies, low volumes of production or challenges in meeting quality requirements.

Land tenure is considered a critical enabling condition for the adoption of SLM technologies. From the projects analysed, lack of secure land tenure proved to be a constraint as project participants such as women and youth were locked out of the projects because they did not have outright access to and control of land. Therefore, during project design such limitations should be considered for particular SLM technologies. There is also need to target men to enhance technology uptake especially in cases where land tenure challenges are predominant.

7.5 Project outcomes and evaluation

It was found that there is scanty documentation of the realised outputs and outcomes. This limits understanding of the extent of SLM adoption. For example most project designs had inclusion of vulnerable groups but from the documentation, outputs of interventions to the disadvantaged groups are not well demonstrated. Therefore a well-structured monitoring and evaluation framework should be put in place and every milestone or setback experienced in a project recorded. Also comprehensive evaluation and reporting strategies should be adopted to ensure project goals are met and lessons learned are documented. Such lessons would benefit implementation of future projects.

7.6 Project design for post-project sustainability

Projects should have clear exit strategies before commencement of their implementation. The exit strategy design needs to be discussed together with targeted farmers at the onset of project implementation. The endeavour would to a great extent help manage expectations of farmers.

Project designs should endeavour to strengthen partnerships among project stakeholders in order to provide for better knowledge sharing and synergies in the use of resources towards a shared goal and reduce cases of isolated and uncoordinated activities and actors. Strengthening partnerships would also curb the likely fallout of partners at the end of funded activities.

The project design and execution should also put into consideration factors beyond the farmers control that may affect adoption of SLM technologies. These include poor road infrastructure (resulting in high production costs), marketing difficulties and weak agricultural extension services.

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9. Appendix

All projects identified in the study as having SLM technologies

No	Name of the project	Counties implemented	Selection stage	Reason of being selected or not selected
1	Kenya Agricultural Carbon Project (KACP)	Bungoma Kisumu Siaya	Final	Fitted criteria for SLM selection
2	*Striga* Technology Extension Project (STEP)	Kakamega Siaya Bungoma	Final	Fitted criteria for SLM selection
3	National Agriculture and Livestock Extension Project (NALEP)	Kakamega Bungoma Siaya	Final	Fitted criteria for SLM selection
4	Sustainable intensification of maize- legume cropping systems in East and Southern Africa (SIMLESA)	Bungoma Siaya	Final	Fitted criteria for SLM selection
5	Kenya Agricultural Productivity and Agribusiness Project (KAPAP)	Kakamega Siaya	Final	Fitted criteria for SLM selection
6	Linking soil fertility and improved cropping strategies to development interventions	Siaya	Final	Fitted criteria for SLM selection
7	N2Africa Putting Nitrogen Fixation to work for smallholder farmers in Africa	Kakamega Bungoma Siaya	Final	Fitted criteria for SLM selection
8	Strengthening Rural Institutions (SRI) - Enabling rural transformation and grassroots institutional building for sustainable land management project	Bungoma	Final	Fitted criteria for SLM selection
9	Conservation Agriculture for Sustainable Agriculture and Rural Development	Bungoma Siaya	Final	Fitted criteria for SLM selection
10	Upscaling the use of Agricultural Lime to Enhance Soil Health for Increased Crop Production in Acidic Soils of Western Kenya project	Kakamega Siaya	Final	Fitted criteria for SLM selection
11	Scaling up sustainable land management and agrobiodiversity conservation to reduce environmental degradation in small-scale agriculture in Western Kenya	Kakamega	Second	Implementation information lacking
12	Supporting investments in upscaling of grain legumes in western Kenya through assessing and modelling the threat of biotic stressors	Kakamega	Second	Research study under controlled farm plots
13	Integrated soil fertility management in practice in western (Siaya) Kenya	Nyabeda, Siaya District, Kakamega and Bondo districts in western Kenya	Second	Research study under controlled farm plots
14	Western Kenya District-based Agricultural Development Project	Bungoma, Kakamega	First	Considered a non-performing Project of IFAD
15	Western Kenya Integrated Ecosystem Management Project	Western Kenya along the rivers Nyando, Nzoia and Yala	Second	Very broad

No	Name of the project	Counties implemented	Selection stage	Reason of being selected or not selected
16	Rainwater Harvesting	Kakamega, Bungoma	First	Very scanty details available
17	Project Mbuzi (Dairy Goat project)	Kakamega, Bungoma	First	Very scanty details available
18	Development and transfer of conservation agriculture production systems (CAPS) -	Bungoma	Second	An academic research
19	Lake Victoria Environment Management Project I (LVEMP I)	Siaya	Second	Outside target period
20	Lake Victoria Environment Management Project II (LVEMPII)	Siaya	First	Outside target period
21	Smallholder Dairy Commercialisation programme	Bungoma	First	Not closely fitting criteria for SLM projects selection
22	Strengthening capacity for climate change adaptation in Kenya through sustainable land and water management in sub-Saharan Africa	Bungoma, Siaya, Machakos and Mbeere	Second	Very scanty details available
23	Western Kenya CDD/Flood Mitigation Programme	Kakamega, Siaya Bungoma	Second	Not closely fitting criteria for SLM projects selection
24	Soil protection and Rehabilitation	Kakamega, Bungoma, Siaya	First	Current GIZ Soil Rehab Project
25	Supporting food security and reducing poverty in Kenya and Tanzania through dynamic conservation of globally important agricultural heritage systems(GIAHS)	Bungoma, Siaya	First	Not closely fitting criteria for SLM projects selection
26	Promotion of sustainable sweet potato production and post-harvest management through farmer field schools in East Africa	Kakamega	First	Not closely fitting criteria for SLM projects selection
27	Improving smallholder maize production in western Kenya through ISFM	Kakamega, Siaya	Second	Very scanty details available
28	Soil fertility replenishment and recapitalisation project		First	Project outside of criteria time frame
29	Soya Bean farming Project	Bungoma	First	Insufficient information
30	CA2Africa - Conservation Agriculture to Africa	Bungoma	First	Weighted against another CA project
31	Sustainable intensification Trees	Kakamega, Bungoma, Siaya	First	This was a baseline survey
32	Agricultural Productivity and Sustainable Land Management	Kakamega, Siaya	First	Insufficient information
33	Sustaining Agriculture through Climate Change	Bungoma, Siaya	First	Still at design stage

No	Name of the project	Counties implemented	Selection stage	Reason of being selected or not selected
34	KARI Farmer Field School Pilot project	Kakamega, Bungoma	First	Insufficient information
35	Integrated Soil Fertility Management and Poverty traps in western Kenya	Kakamega, Siaya	First	A research study; not a development project
36	Strengthening citrus production systems through the introduction of integrated pest management measures	Bungoma, Siaya	First	Project outside of criteria time frame
37	SLM Charcoal project for improved livelihoods	Bungoma	First	Insufficient information
38	The Carbon Benefits Project: Modelling, Measurement and Monitoring	Kakamega	First	A research study; not a development project
39	Conservative Agriculture with trees	Bungoma, Siaya	Second	Relatively short implementation period
40	Africa Adaptation Programme	Bungoma, Siaya	First	Relatively short implementation period
41	Combined use of organic and inorganic plant nutrients	Siaya	First	An academic research
42	Rainwater Harvesting	Siaya	First	School-based; insufficient information
43	Kenya Agroforestry Extension Programme	Siaya	First	Project outside of criteria time frame
44	Extending the (push-pull) technology for East Africa smallholder Agriculture	Siaya, Bungoma, Kakamega	First	Scientific: developing technologies
45	Agricultural Sector Development Support Programme	Siaya, Bungoma, Kakamega	Second	National-wide; too broad