IFAD
Investing in rural people

SUSTAINABLE AGRICULTURAL INTENSIFICATION PRACTICES

EAST AND SOUTHERN AFRICA

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ISBN 978-92-9266-312-4

Printed May 2023

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ACKNOWLEDGEMENTS

Originators: Putso Nyathi, Senior Regional Agronomist in the East and Southern Africa Division of IFAD, with support from Walter Mupangwa, IFAD consultant.

Contributors (all from IFAD): Robert Delve (technical review and backstopping); Richard Abila, contribution to the section on fisheries and aquaculture; Marjen Leneman, review of livestock section; Mathilde Iwiens, peer reviewer; Viviane Filippi, peer reviewer; Amine Belhamissi, reviewer; Arthur Mabiso, reviewer; Clemence Moinier, Mathew John Mather, Simone Mahousssi Assocle and Marie-Aude Even of the Biodiversity Team; and Paxina Chileshe and Zira Mavunganidze for work on the environment and climate mainstreaming aspects.

Thanks to the East and Southern Africa Knowledge Management Team – Daniel Higgins, Baptiste Renard and Sara Fornabaio and Sara Mbago Bhunu the ESA Regional Director – for the support, and to the Research and Impact Assessment Division and the Agricultural Research for Development Team for sharing relevant documents, thus making the review possible.

ACRONYMS

AD2M	Project to Support Development in the Menabe and Melaky Regions
CGIAR	Consultative Group on International Agricultural Research
CIAT	International Center for Tropical Agriculture
CIFOR	Center for International Forestry Research
COMACO	Community Markets for Conservation
CSA	climate-smart agriculture
ESA	East and Southern Africa
E-SLIP	Enhanced Smallholder Livestock Investment Programme
FFS	farmer field school
IFAD	International Fund for Agricultural Development
ILRI	International Livestock Research Institute
INBAR	International Bamboo and Rattan Organization
IPM	integrated pest management
ISFM	integrated soil fertility management
KCEP-CRAL	Kenya Cereal Enhancement Programme – Climate Resilient Agricultural Livelihoods Window
MTR	mid-term review
PASIDIP	Participatory Small-scale Irrigation Development Programme
PRELNOR	Project for the Restoration of Livelihoods in the Northern Region
PRICE	Project for Rural Income through Exports
PROSUL	Pro-Poor Value Chain Development Project in the Maputo and Limpopo Corridors
RDDP	Rwanda Dairy Development Project
S3P	Smallholder Productivity Promotion Programme
SADP	Smallholder Agriculture Development Project
SAPP	Sustainable Agricultural Production Programme
SDCP	Smallholder Dairy Commercialization Project
SAI	sustainable agricultural intensification
UTaNRMP	Upper Tana Catchment Natural Resource Management Project

RATIONALE FOR DEVELOPING PATHWAYS FOR SUSTAINABLE AGRICULTURAL INTENSIFICATION

EAST AND SOUTHERN AFRICA

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Smallholder farming systems in East and Southern Africa (ESA) face multiple challenges related to crop, livestock and fish productivity. These challenges affect household food and nutrition security in rural communities that are largely dependent on agriculture. Sustainable agricultural intensification (SAI) practices can close yield gaps in the smallholder farming sector in ESA (Wilkus et al., 2021). Low crop productivity on smallholder farms arises from poor soil fertility, the use of unimproved crop varieties, climate change, unsustainable farming practices, rainfall variability, and pests and diseases. Similarly, low productivity in the livestock and fish industries is attributed to the rearing of poorly adapted breeds with low productivity, inappropriate animal health management and poor-quality feed resources (Adeleke et al., 2021). Through increased extreme conditions such as droughts, floods and heat, climate change negatively affects livestock productivity. Limited access to agricultural input-output markets for crop, livestock and fish industries compounds the negative impact of the biophysical challenges that smallholder farmers face. To complement improved crop/livestock/fish productivity, sustainable land and livestock/fish farm management and increased access to input-output markets are critical requirements for smallholder agriculture to succeed. The degradation of farm and pasture land and watersheds is common in rural communities, and farmland is affected by soil erosion due to unsustainable conventional tillage and a lack of appropriate soil and water conservation practices (Nord et al., 2022; Sosibo et al., 2022). Sustainable land and water management strengthens and enriches biological interactions that favour increased crop, livestock and fish productivity in a profitable and ecologically friendly manner.

IFAD supports the development of smallholder agricultural systems with the aim of improving the food and nutrition security and livelihoods of poor rural households. IFAD-funded projects promote various SAI practices to improve crop, livestock and fish productivity on smallholder farms, reduce land degradation, adapt to climate change and protect the environment. While many SAI practices are promoted through IFAD-funded projects, documentation on the IFAD investments has been limited with regard to what exactly is/was promoted, the levels of technology uptake and the crop/livestock/fish productivity benefits that accrued in the smallholder farming sector in ESA. This assessment is therefore based on a need to understand the SAI practices and drivers of and constraints on uptake and to offer solutions to improve productivity in the region. The assessment generates recommendations for the future promotion and improvement of current SAI practices in ESA.

OBJECTIVES OF THE NOTE

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The overall objectives of the note were to identify SAI practices implemented in ESA countries through IFAD-funded loan and grant projects and to recommend best approaches/pathways to promoting SAI practices in ESA. The specific objectives were to (i) identify SAI practices promoted in ESA and assess the drivers of and barriers to their uptake; (ii) identify context-specific best-bet SAI technologies for smallholder farmers in ESA; and (iii) recommend best-bet SAI practices and pathways for improving productivity and other associated benefits such as climate change adaptation and mitigation and biodiversity conservation through SAI promotion within the ESA portfolio.

The note is based on a desk review of 34 loan projects implemented in 17 countries in ESA, namely Angola, Botswana, Burundi, Comoros, Eritrea, Eswatini, Ethiopia, Kenya, Lesotho, Madagascar, Malawi, Mozambique, Rwanda, Tanzania, Uganda, Zambia and Zimbabwe. The projects were selected for review based on the stage of implementation, with the focus on projects that had reached the mid-term review (MTR) stage (15 projects) and completion (16 projects), as these should be able to provide data on productivity and adoption. Projects that had not yet reached the MTR stage were also included to highlight the current set of SAI practices promoted in ESA. The study also identified SAI practices promoted in the IFAD-funded grant projects. Ten reports of ongoing and completed grant projects were reviewed. Eight impact assessment reports of loan projects (were reviewed to gather information on the impact of the various SAI practices implemented on smallholder farms: Smallholder Agriculture Development Project (SADP), Smallholder Productivity Promotion Programme (S3P), Sustainable Agricultural Production Programme (SAPP), Pro-Poor Value Chain Development Project in the Maputo and Limpopo Corridors (PROSUL), Project to Support Development in the Menabe and Melaky Regions (AD2M), Project for Rural Income through Exports (PRICE), Smallholder Dairy Commercialization Project (SDCP) and Participatory Small-scale Irrigation Development Programme Phase II (PASIDP II)). Six case studies were developed based on the impact or success of SAI practices on the targeted beneficiaries and the availability of adequate detail in project completion and impact assessment reports. The case studies also provided evidence that informed the theory of change for the SAI agenda in ESA.

SUSTAINABLE AGRICULTURE INTENSIFICATION

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WHAT IS SUSTAINABLE AGRICULTURE INTENSIFICATION?

Sustainable agricultural intensification seeks to produce more from given land, water or other natural resources, while protecting the environment and increasing economic and social gains in communities (FAO, 2009; Vanlauwe et al., 2010; Oumer et al., 2020). SAI is therefore not a single technology but comprises all practices that contribute to improving productivity and production without area expansion or negative impacts on the environment. SAI practices should also be relevant to the prevailing economic, social, environmental and climatic conditions of smallholder farmers. SAI practices may include the following.

Climate-smart agriculture (CSA) aims at sustainably increasing agricultural productivity and incomes, adapting and building resilience to climate change, and reducing greenhouse gas emissions. It is an integrated approach to managing landscapes – cropland, livestock, forests and fisheries – that addresses the interlinked challenges of food security and climate change.[1] CSA includes practices such as crop diversification, crop rotation and intercropping, mulching, minimum tillage, soil and water conservation, precision irrigation, agroforestry, improved forage production and grazing management for improved livestock feeding, improved livestock and fish breeds, the growing of stress-tolerant crop varieties, and the sustainable management of natural resources for food production.

Conservation agriculture is a crop and land management system based on three principles – minimum soil disturbance (by reducing or no tilling), crop residue retention or soil cover, and crop diversification/crop rotation – among other complementary good agricultural practices needed to support its functioning.

Integrated soil fertility management (ISFM) is the application of soil fertility management practices and the knowledge to adapt these to local conditions. It maximizes fertilizer and organic resource use efficiency and crop productivity. The practices include appropriate fertilizer and organic inputs combined with the use of improved germplasm.

Integrated pest management is the consolidation of all available pest control techniques to prevent the development of pest populations. It combines biological, chemical, physical and crop-specific (cultural) management strategies and practices to grow healthy crops and minimize pesticide use and environmental pollution.

The system of **rice intensification** is a more intensive, productive and sustainable method of growing rice that efficiently uses fertility amendments and increases crop density per unit area.

Post-harvest management is a system of quality management and loss reduction along the supply chain (https://www.fao.org/platform-food-loss-waste/en).

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1. https://www.worldbank.org/en/topic/climate-smart-agriculture

In **livestock production**, the intensification of livestock systems is the process of modifying production practices to increase output per animal, per unit of land and per unit of labour (Nicholson et al., 1995). The practices may include keeping improved breeds, improving feeding through fodder production and controlled grazing/pasture improvements and providing health care.

In **aquaculture**, practices include growing high-quality adapted fish species, fingerlings/fish seed multiplication using hatcheries, providing nutritious commercial feed, developing supplementary fish feed using insects (termites, earthworms, black soldier flies) and diversifying fish species (catfish, tilapia, carp). Aquaculture practices are generally categorized as "intensive", "semi-intensive" or "extensive" depending on the technology, level of input (especially quality and quantity of feed and seed), level of management, productivity, etc. At the top end, intensive aquaculture will involve high-quality seed, high seed stocking rates, the use of high quality and quantity feed, good water management (sometimes involving recirculation to increase oxygen content) and good systems management practices, resulting in high productivity.

Agroecology and **agroecological intensification** refer to an integrated approach that applies both ecological and social concepts and principles to agricultural production systems.

An integrated crop-livestock system consists of interactions between crop and animal production across time and space and maximizes the synergies between the two farming industries to increase productivity and resilience in the farming system.

Soil and water conservation is a practice that sustainably enhances land productivity and nutrition and also natural resources such as soil water and plant health and capacity. It helps in controlling run-off; reducing soil erosion and compaction; improving soil fertility; increasing soil water availability; enhancing soil and crop nutrients recycling; conserving or draining water; and, therefore, improving household food and nutrition security.

PATHWAYS FOR IMPROVING SAI PRACTICE UPTAKE IN ESA (THEORY OF CHANGE)

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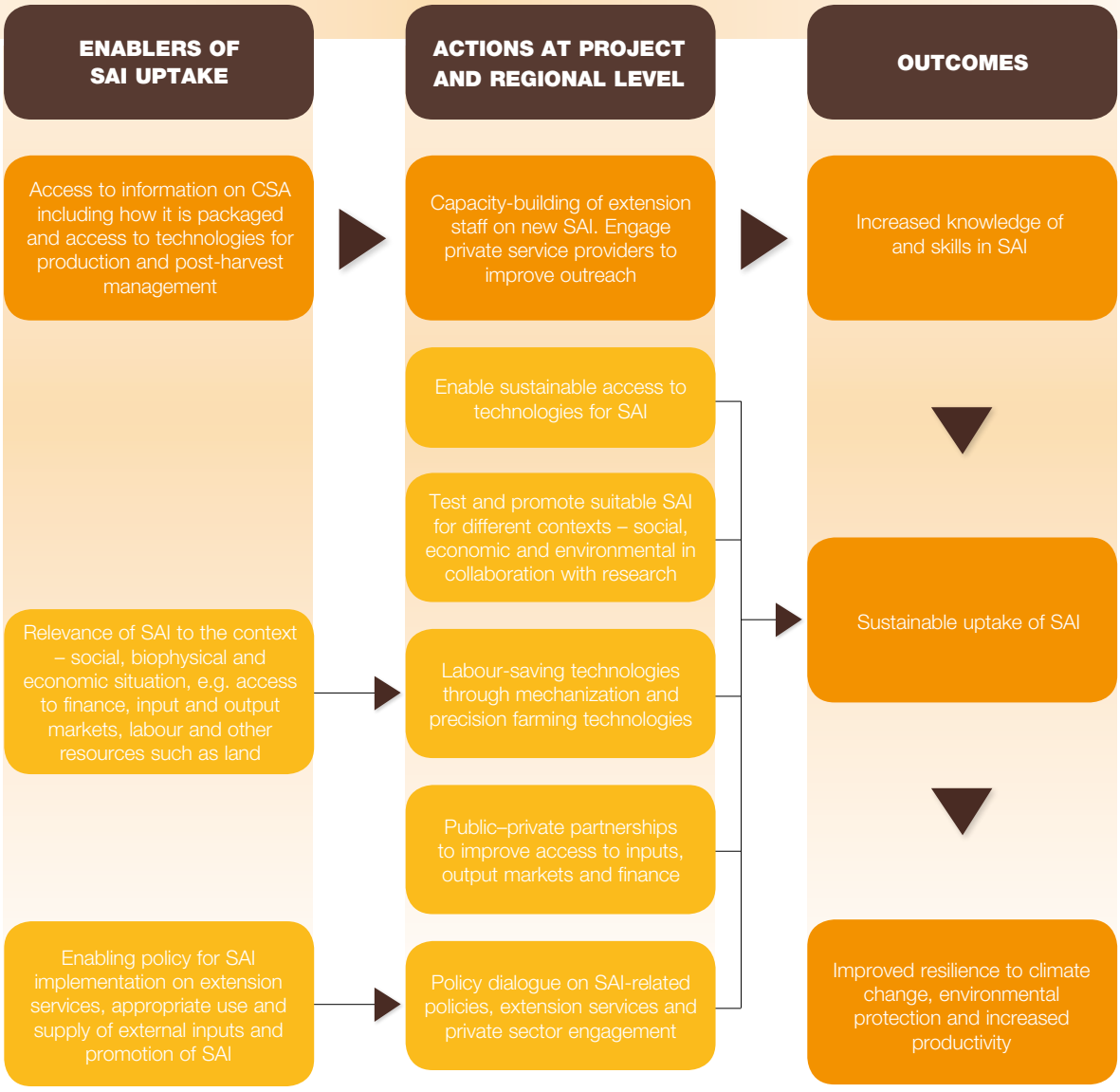
The review of SAI practices promoted through IFAD-funded projects revealed a number of enablers of and constraints on the uptake of SAI practices among farmers and the impacts of SAI practices on agriculture productivity. Based on these findings, pathways for improving productivity through SAI practices in ESA are presented. Figure 1 illustrates the theory of change to improve the uptake of SAI practices and increase productivity.

FIGURE 1. THE KEY REQUIRED ENABLERS AND ACTIONS FOR THE PROMOTION OF SAI PRACTICES IN ESA AND EXPECTED OUTCOMES



KEY ENABLERS OF, CONSTRAINTS ON AND ENTRY POINTS FOR IMPLEMENTING SAI PRACTICES IN ESA

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(1) Access to extension services is a key enabler of SAI uptake and increased productivity because of the knowledge farmers gain of the improved technologies: The adequate and timely training of farmers and the various facilitators of activities promoted in IFAD projects increased the uptake of SAI practices. The use of pluralistic extension services and last-mile extension service providers such as farmer field schools (FFSs) and lead-follower farmer approaches, and the increase in farmers' interactions with extension services and researchers through on-farm demonstrations, increased farmers' knowledge and skills, resulting in an increased uptake of SAI practices (see **case study 4**). Such pluralistic approaches were incorporated into IFAD-funded projects as a result of inadequate public extension services. IFAD projects disseminated SAI practices in a number of ways (**annex 7**), including research-extension led (on-farm demonstrations, field days, learning exchanges), farmer to farmer (including the use of lead farmers, farmer field schools [FFS], community based facilitators), e-extension (including radio, television, audio-visual resources, text messaging, workshops, conferences and social media, e.g. WhatsApp), information materials (posters, bulletins, brochures, fact sheets and pamphlets) and value chain driven development through contracts or extensions led by private service providers such as off-takers, agro-dealers and machinery service providers.

(2) Access to inputs: A review of IFAD-funded projects shows that the uptake of SAI practices increased with improved access to high-quality, improved, climate-adapted and environmentally sustainable inputs (including bio-inputs) through agro-dealers, seed multiplication groups including community seed banks, e-vouchers and seed fairs. This was demonstrated under the Sustainable Agriculture Production Programme (SAPP) project in Malawi, the Project for the Restoration of Livelihoods in the Northern Region (PRELNOR) in Uganda and the Kenya Cereal Enhancement Programme – Climate Resilient Agricultural Livelihoods Window (KCEP–CRAL) project in Kenya (**case study 6**). The multiplication of seed (cereals, pulses, and forage), cuttings (cassava, Irish potatoes) and fish fingerlings increases timely access to critical inputs for crop, livestock and fish enterprises in the smallholder farming sector.

Potential constraints on input access

While linking farmers to input markets is one step towards improving the uptake of SAI practices, the high cost of inputs may limit SAI promotion. For example, in Kenya, where e-vouchers were used to subsidize inputs, a number of farmers, particularly in semi-arid areas, were only able to access e-voucher inputs at 10 per cent contribution but were not able to pay for subsequent years when they had to contribute 40 per cent or more because of high costs and droughts, which then affected consistent uptake of the improved technologies. In some areas, certified/improved agriculture or aquaculture seed is not available, which will negatively affect any SAI intentions.

(3) Access to output markets: Having an assured market for crop and livestock products was an incentive for farmers to aim at increasing productivity through the uptake of SAI practices. The Pro-Poor Value Chain Development in the Maputo and Limpopo Corridors (PROSUL) in Mozambique and Project for Rural incomes through Exports (PRICE) in Rwanda linked farmers to output markets, and this in turn contributed to the high adoption of SAI practices, including post-harvest management practices for quality assurance (**case study 7**). In Mozambique, the likelihood of adopting SAI practices for improved and disease-free cassava was 65 per cent, and adoption was driven by the availability of the cassava market developed through the project. In Zambia, SAI adoption averaged 34 per cent under the Smallholder Productivity Promotion programme (S3P), where market links and a premium were offered to farmers who produced following specific SAI practices. Such links are key to the uptake of SAI practices.

(4) Access to highly productive farming technologies, tools and equipment: As well as inputs, farmers need the right technologies to achieve sustainable agricultural/aquaculture intensification. These include tools and equipment for farming, harvesting and preserving, transporting, processing and marketing. Pre- and post-harvest loss methods are also important to achieving SAI objectives. IFAD loan projects have supported activities to address such challenges by providing mechanization services in PRELNOR, Uganda and KCEP-CRAL then matching grant facilities in the Smallholder Agriculture Development Project (SADP) in Lesotho to enable farmers to invest in instruments such as land preparation tools, post-harvest equipment and shednets.

***Potential constraints on uptake of tools and equipmen*t**

Tools and equipment imported from developed countries might not be adapted to the biophysical conditions in some parts of ESA. Local manufacturing of tools and equipment might be hampered by a lack of technical know-how in the private sector and shortage of foreign currency to import the parts needed to produce the tools and equipment required by smallholder farmers in ESA. The uptake of tools and equipment among smallholder farmers can be limited because of high costs and the lack of after-sales services and spare parts in rural communities.

(5) Relevance of promoted SAI practices to the context of smallholder farmers: SAI practices promoted by IFAD projects are relevant to most agroecological zones of the target region and have been disseminated to vulnerable households such as those led by women. The practices mostly address issues of soil fertility, land degradation, water scarcity and low productivity of crop varieties and livestock breeds. However, consideration is needed of the requirements of different social groups (women, men, youth and indigenous peoples) and the resource constraints that may limit the uptake of SAI practices. For example ISFM practices such as the use of organic fertilizers require access to manure, while the use of crop residues as soil cover requires high biomass production and is not suitable in places where crop residues have multiple uses, such as for livestock feeding and roofing, particularly the case in semi-arid areas.

Some SAI practices also tend to increase workloads, particularly for women; for example, hand-dug conservation tillage/potholing methods may be more labour-intensive for women. With the advent of new technologies, appropriate sustainable farm mechanization options, such as no-till equipment, rippers, planters, threshers and shellers, can reduce the drudgery of farming activities.

Blanket recommendations of inorganic fertilizers should also be avoided as the fertilizers in question may be unsuitable for and inefficient in the specific context.

To increase livestock productivity, the animal species and breeds used should be adapted to the target agroecological conditions. For example, dairy cows can be promoted in sub-humid to humid areas where biomass is available for feed, and the hardier beef cattle and goats should be promoted in semi-arid to arid zones. In addition, fodder production and use should supplement natural grazing, improving animal health to increase farm profits. To reap the maximum benefits from new technologies and practices implemented by smallholder livestock farmers, improving and adapting livestock breeds is usually required. Genetic diversity within livestock breeds and variation in feed can also be encouraged to increase the resilience of cattle and improve their health and reduce the need for external inputs, including antibiotics.

The post-harvest management of crop, livestock and fish products should be promoted to minimize losses and maintain quality. For example, drying technologies can be promoted for crops in humid areas of ESA, as can drying and cooling technologies in fishery systems across all agroecologies of ESA. In addition, improved post-harvest grain storage can reduce losses due to pests and contamination by aflatoxins.

BEST-BET SAI PRACTICES FOR ESA

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The SAI practices listed in table 1 are adapted to the agroecological zones of ESA, which include low-altitude dry and moist savannah and semi-arid and sub-humid areas. The SAI practices are also suitable for mid-altitude semi-arid and sub-humid and low-altitude semi-arid areas of ESA. It should be noted that SAI is not just about applying one technique or another – it is about having a larger view of the ecosystem and what can be done to make the best sustainable use of natural resources and achieve efficient production.

TABLE 1. BEST-BET SAI PRACTICES FOR ESA

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
Conservation agriculture, which includes the following principles: *Minimum soil disturbance or no till* Includes: • Ripping • Zai pits/potholing • Half moons • Jab planting	• Soil degradation/ disturbance and water conservation • Soil biodiversity loss	• Access to minimum tillage implements for land preparation and labour-saving methods for controlling weeds • Areas prone to flooding may require raised beds to avoid waterlogging • Context-specific in terms of soils, farming systems (in relation to timing of land preparation) and socio-economic status of farmers • Availability of cover crops and herbicides to control weeds	All agroecological zones of ESA. Very good for water harvesting in **arid and semi-arid** areas, using **potholes/zai pits**
Soil cover/mulching • Use of crop residues • Use of grass • Use of cover crops such as *Mucuna*, *Lablab*	• Low soil organic matter • Water retention • Reduction of weeds • Soil moisture retention • Soil and crop nutrients recycling and provision • Protection against soil erosion and intense sunlight	• Availability of biomass • Option to use live cover crops together with the main crop, but ensure no competition with main crop, e.g. cowpeas, *Lablab*, *Mucuna*, sunn hemp • Usually difficult to promote in dry areas where biomass is limited. Cover crops can be an option	Sub-humid and humid areas Cover crops can be grown in semi-arid and arid areas

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
Crop rotation • Different species – legumes with cereals • Different types of vegetables such as fruit, root, leafy	• Soil fertility • Pest and disease management • Reduction of weed pressure and soil erosion • Nutrition • Soil structure and organic matter degradation	• Availability of seeds and farmers have enough land to practice rotation	All agroecological zones of ESA. In semi-arid and arid areas, avoid a situation where intercropping increases competition for soil moisture for crops
Intercropping, growing different crop species in one field	• Soil fertility • Resilience to shocks, e.g. climate and markets • Nutrient recycling/ improve nutrition • Pest and disease management • Pollination • Soil biodiversity • Soil restoration	• Access to diversified inputs, and in areas with limited landholding • For market-oriented production, consider efforts not to avoid competition with the main crop e.g. through strip cropping (https://rdcu.be/cWngW) • Promote indigenous crops for adaptation, nutrition and biodiversity	
Integrated soil fertility management: use of inorganic and organic fertilizers together such as: *Compost*	• Soil fertility and land degradation challenges • Soil biodiversity • Soil organic matter restoration • Pest and disease management • Low productivity	• All areas in ESA with low soil fertility • Access to labour and required inputs for compost making • Compost is applicable for high-value crops (horticulture and small plots)	All agroecological zones of ESA. Application rates differ by agroecological region, **use less rates in arid and semi-arid** areas
Inorganic fertilizer		• Need to know crop nutrient requirements and soil nutrient levels through soil tests (https://agra.org/malawis-ministry-plans-area-specific-fertilizer-trials)	

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
Inorganic fertilizer	• Soil fertility • Pest and disease management • Reduction of weed pressure and soil erosion • Nutrition • Soil structure and organic matter degradation	• Targeted and timely application, e.g. micro-dosing sufficient (https://doi.org/10.1007/s10705-008-9200-4) • Affordability of fertilizers is important	All agroecological zones of ESA. Application rates differ by agroecological region, **use less rates in arid and semi-arid** areas
Kraal manure	• Soil fertility • Yield • Pest and disease management	• Manure use depends on availability, e.g. livestock ownership	
Integrated pest management: use of natural, cultural, physical and chemical methods to control pests. Chemicals are used as the last resort. Also includes push-pull technologies (https://www.ifad.org/en/web/latest/-/hungry-caterpillars-threaten-kenya-crops-can-plants-provide-natural-pest-control)	• Pest and disease control • Reduce chemical inputs used • Reduce risk to human and animal health • Environment protection/ avoid pollution	• All farmers in ESA • Technical know-how on usage • Access to chemical and biological pest control options • Knowledge of different options for pest control	All agroecological zones of ESA
Improved crop varieties • Short season varieties/ early maturing • Drought/flood tolerant/ heat/climate resistant • Pest and disease resistant • High yield • High nutrition content	• Low productivity • Resilience to shocks/ stresses • Nutrition	• Adaptable to local conditions, evaluated by communities for acceptability • Supportive seed policies and policy environment • Access to markets to obtain and sell seeds	In arid and semi-arid zones of ESA. Use drought-tolerant varieties, and early maturing varieties for short season, low rainfall areas

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
Sustainable land and water management *Irrigation technologies such as:* • Drip irrigation • Sprinkler • Efficient irrigation water scheduling Water pans	• Droughts • Low productivity	• Availability of irrigation equipment • Availability of irrigation water • Instances where high-value crops are being produced • Potential for high-value crop production	Areas prone to drought but have potential for water harvesting Water pans need to be accompanied by technologies for irrigation, e.g. water pumps
Post-harvest management • Coolers • Dryers • Grain storage for pest controls	• Post-harvest losses	• Technologies for specific crops/produce and agroecological condition are required • Access to affordable grain storage technologies (e.g. hermetic bags and tarpaulins) (https://www.ifad.org/en/food-loss-reduction)	All areas. Types depend on the agroecological regions
Improved livestock production • Efficient production and use of feed/forage • Integrated livestock-cropping systems • Use of improved breeds • Use of improved livestock housing • Improved animal husbandry and health management	• Soil productivity • Livestock productivity • Nutrition • Livestock health and resilience • Limited access to inputs	• Breeds adaptable to local conditions • Access to affordable technologies and infrastructure • Knowledge of livestock nutrition, husbandry requirements • Supportive land rights • Access to productive grazing areas and/or feed and animal health services	Beef production in the semi-arid areas, dairy mostly in high potential areas with enough forage Small stock in semi-arid and arid areas
Improved fish production • Use of improved adapted breeds • Use of improved adapted feed		• Breeds adaptable to local conditions • Knowledge of breeds' nutrition requirements • Access to feed	Coastal zones and inland regions around large water bodies (lakes, rivers, dams, etc.) of ESA where farmers produce fish in farm ponds

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
Improved fish feed application • Use of certified high-quality fish feed • Increasing fish feed to optimal levels • Increased efficiency of feed application by using floating pellet feed, using demand-triggered feeding equipment • Use of local farm produced feed, incorporating insects to increase protein content	Low productivity and slow fish growth rate due to: • Suboptimal quantities of feed • Inefficient feed application methods High cost of feed	• High-quality fish feed is available • Farmers can afford quality feed • Extension services and other modes of skills development to train farmers in feed formulation and application • Functional financial services	Coastal zones and inland regions around large water bodies (lakes, rivers, dams, etc.) of ESA where farmers produce fish in farm ponds
Improved aquaculture seed application • Use of genetically improved seed • Increased fish stocking rates • The right choice of species adapted to local conditions	Low productivity due to: • Low fish stocking rates • Poor growth rates • Poor choice of species that are not adapted to local environment	• Improved quality seed is available • Farmers can afford quality seed • Extension services to build skills on fish seeds management	
Aquaculture diversification • Polyculture, combining multiple species in one pond • Integrated aquaculture-crop livestock	• Resource and water use efficiency • Risk reduction • Livelihood diversification • Production waste management	• Extension services to build skills in polyculture and integrated aquaculture methods	

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
Improved water management • Use of pond-lining materials to minimize water seepage • Improved pond design (e.g. deeper ponds for better water retention and mitigating floods; good elevation for circulation; raised ponds to reduce construction costs and mitigate floods) • Use raceways technology for better circulation/higher productivity • Water quality monitoring for early warning (oxygen, ammonia, pesticides, etc.) • Investing in water canals • Cover pond with net to minimize fish loss from floods	Low productivity and mitigating climate risks (droughts, floods, etc.)	• Public services, e.g. water canals, water quality monitoring • Extension services to train farmers in water management methods • Farmers have access to finance, e.g. for constructing good ponds	Coastal zones and inland regions around large water bodies (lakes, rivers, dams, etc.) of ESA where farmers produce fish in farm ponds
Actions to prevent pre- and post-harvest losses • Net cover and fencing ponds to prevent predators • Use solar technologies for fish preservation • Solar-powered fish cooler boxes • Strong market linkages	Food losses during production and post-harvest	• Extension services to build skills in food loss management • Farmers have access to finance to buy tools and equipment for fish preservation	

SAI PRACTICE	CHALLENGE ADDRESSED	APPLICABILITY AND REQUIREMENTS FOR SUCCESS	TARGET AGROECOLOGICAL ZONES OF ESA*
• Landscape approach Projects should invest in activities that not only promote productivity on farm but also support the management of land and water resources that support the production system, practices such as terraces, bee-keeping, watershed management, agroforestry	• Land degradation is an issue • High livestock population • Low landholdings • Wastage • Lack of integration	• Community engagement • Ensure benefits beyond farm productivity even for those who will not benefit from interventions on farms, e.g. through bee-keeping activities, carbon markets, payment for ecosystem services	All areas
• Integrated crop-livestock-aquaculture systems	• Climate and market vulnerability and low adaptive capacity • Food and nutrition insecurity	• Access to water for aquaculture • Access to markets • Access to land	All areas Crop and livestock combinations depend on the agroecological regions

* An agroecological zone is a land resource mapping unit, defined in terms of climate, landform and soils, and/or land cover, and having a specific range of potential and constraints for land use.

CURRENT GAPS AND OPPORTUNITIES IN SAI AT IFAD

- **Monitoring and evaluation:** outcomes need to be monitored over longer periods of time to give an understanding of the effects of SAI practices, and project completion reports need to report on outcomes and output indicators rather than process indicators.
- **Research:** Linked to monitoring and evaluation, it would be useful to document/know which combinations of SAI practices make the greatest impact in terms of resilience to climate shocks and productivity.
- **Extension methods:** Many extension methods exist, such as demonstration plots, FFS, field days, ICT methods and exchange visits. It is important that the Research and Impact Assessment Division evaluate the effectiveness of these extension methods and help implementers to prioritize.
- **Leveraging synergies with biodiversity to enhance SAI impact and access to funding:**
  - **Global Biodiversity Framework** – Among others of relevance, target 10 of the Global Biodiversity Framework requires that parties "ensure that areas under agriculture, aquaculture, fisheries and forestry are managed sustainably, in particular through the sustainable use of biodiversity, including through a substantial increase of the application of biodiversity friendly practices, such as sustainable intensification, agroecological and other innovative approaches." SAI practices constitute one way to achieve this target, as long as biodiversity is mainstreamed and, as a result, can leverage biodiversity funds.
  - **Nature-based solutions financing** – SAI practices leveraging ecosystem services and biodiversity resources can be included in nature-based solutions investment tracking mechanisms and be eligible for nature-based solutions finance.
  - **Biodiversity indicator** – Applying the biodiversity core indicator is mandatory for projects that receive nature-based solutions finance. The indicator monitors the sustainability of SAI interventions and supports projects' access to nature-based solutions finance.

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RECOMMENDATIONS ON PROMOTING SAI IN ESA THROUGH PROJECTS

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AT PROJECT DESIGN STAGE

There is a need to identify available SAI practices, those that have been tested in the particular country and new ones that can be introduced in a project area. Participatory rural appraisal can be used during the project design process where possible to assess the area's needs and the project's relevance. Active engagement of smallholder farmers and governments in the preliminary stages of project design is a key ingredient in the future uptake of SAI practices.

Initiate partnerships: Partnerships are important for the effective and efficient delivery of different components in development projects. Projects should collaborate with research and extension departments, private sector actors involved in input-output markets and finance supply, local NGOs, and international research organizations to enable the successful promotion of SAI practices in the following ways:

- Engage with local research organizations and extension systems to identify capacity gaps in the implementation of such practices.
- Identify potential partners with a comparative advantage in supporting market access and the ability to conduct socio-economic analysis along the value chain to anticipate market dynamics (e.g. price changes and their effects).
- Where SAI practices have not been piloted in a country, establish partnerships with research to enable testing and evaluating.
- In areas of limited capacity, and depending on the context, include a capacity development programme for implementing partners or consider working with private service providers if the context allows.
- Assess the target population and the impacts of promoting SAI practices on increased labour and other farming input requirements (costs) and sustainability, and find alternatives where bottlenecks are identified.

Undertake a policy assessment: The policy environment will directly influence an intervention's sustainability and impact. For example, transport and private sector engagement policies may affect access to inputs and machinery, seed policies, regulations and/or subventions, which can compromise production systems' resilience, and land ownership can remove incentives to improve management practices. A baseline cross-sectoral policy assessment is essential to understand the existing positive and negative incentives that may support or conflict with SAI practices. This can in turn help to define activities that are aligned with the policy and regulatory framework or suggest activities to reform it.

Undertake a baseline assessment: Projects should also assess the baseline ecosystem conditions in the area of intervention, the ecosystem services' flows at landscape level, the soil quality and the species abundance. The challenges identified can form an integral part of the theory of change. This enables the definition of interventions that build on existing SAI practices while ensuring that they do not contribute to biodiversity loss or disrupt ecosystem services at landscape level, thereby ensuring that the intensification is indeed

sustainable. Assessments can be conducted using the Adaptation, Biodiversity and Carbon Mapping Tool,[2] and progress can be monitored using the Biodiversity Core Indicator.

AT PROJECT IMPLEMENTATION STAGE

Develop the capacity of identified project partners: The various stakeholders supporting project implementation and operating along the value chains used for promoting SAI practices need to be trained to efficiently deliver their contributions and harmonize messaging. A training needs assessment of the stakeholder categories is an important step before the onset of the projects on the SAI practices and implementation approaches to be used. Following the identification of gaps in design, partners need to be trained in the harmonization of messaging.

Prioritize SAI practices to be promoted in one project: All IFAD loan projects promote SAI practices relevant to the biophysical and socio-economic constraints in the selected rural communities. While an integrated approach is required to ensure that interventions improving productivity and climate change adaptation are sustainable, projects should avoid promoting too many SAI practices at the same time, as this can overwhelm targeted smallholder farmers in project communities. Instead, promote SAI practices that are well integrated, and avoid introducing new practices that may increase costs while complicating the application of these practices. The following should be done in the prioritization of SAI practices:

a) **Actively engage rural communities, government and implementing partners** at the onset to jointly prioritize SAI practices to be included in projects. This assessment should consider applicability to the context, knowledge of performance or uptake in the literature and what the project would do to ensure sustained uptake of such practices.

b) **Adapt technologies to local context**: Always test innovations through local research centres, Consultative Group on International Agricultural Research (CGIAR) centres and extension staff by carrying out on-station research, farmer-led research and on-farm demonstrations, and conduct participatory evaluations of innovations before scaling these up. These tests are not only limited to crops but can include livestock technologies, for example incubator technologies and housing construction, and also improved fishery technologies. After testing, carry out a participatory assessment of the technology before it is disseminated to farmers.

c) **Consider locally available solutions/inputs to reduce costs:** Community seed multiplication technically backstopped by research and extension is an option for increasing farmers' access to improved seed inputs. Training local youth and artisans to make, maintain and service equipment can reduce costs and increase uptake. Livestock feed production and feed formulation using locally available resources at community level offer an option for making feed available to farmers and replacing expensive commercial feed, as demonstrated in the loan projects. In aquaculture, the use of feed produced by local farms, possibly with insects included to increase protein content, can substantially reduce feed costs and the overall cost of production.

2. https://abc-map.org/

Adopting integrated methods of pest and disease control can also reduce costs compared with using externally sourced inputs.

d) **Promote labour-saving technologies through hire services and improving access to appropriate tools/equipment:** Hire services for machinery in the production system will reduce labour requirements and create income-generating opportunities for service providers. Such labour-saving technologies include equipment for land preparation, spraying and weeding services, and harvesting. Through financing facilities and training young people and entrepreneurs to provide mechanization services, farmers can access equipment and tools that reduce labour.

e) **Consider a landscape approach to SAI promotion:** For many decades, improved SAI technologies and practices targeted at increasing crop and livestock productivity in mixed farming systems have been promoted separately on farms, with limited integration of the practices into the whole landscape. Projects should include activities that not only promote productivity on farms but also support the management of land and water resources that support the production system, thereby improving conservation and sustainable biodiversity and nutrition.

f) **Consider crop-livestock-aquaculture integration:** The integration of different enterprises should depend on the needs of households. A farmer may have one major enterprise as the focus and other enterprises providing support services, such as rice-based farming integrated with fish, crop and livestock integration. This promotes biodiversity and nutrition and builds resilience in smallholder production systems.

g) **Disseminate SAI practices:** This could be through government extension or service providers and through the integration of digital extension services. See the extension note on lessons on pluralistic extension services for more detail. https://www.ifad.org/en/web/knowledge/-/lessons-learned-from-supporting-pluralistic-extension-services-in-asia-and-africa. Extension methods should be chosen based on their effectiveness and appropriateness to the context.

h) **Strengthen monitoring and evaluation:** Understanding the status quo and establishing a baseline before introducing development programmes in rural communities is important in assessing the impact of SAI technologies and practices. To assess the intended outcomes and impact of SAI interventions on rural communities, appropriate progress indicators beyond IFAD core indicators need to be set and monitored during the implementation of project activities. The most important indicators for SAI promotion are:

- Documenting data from on-farm and on-station demonstrations and FFS fields and compare these with farmers' practices to assess the impact of SAI on crop productivity.
- Documenting the effectiveness of demonstrations, FFS and field days in increasing the uptake of SAI.
- Documenting the uptake of SAI practices by farmers and disaggregate the information for each practice, including the barriers to uptake.
- Documenting the productivity and income data arising from the application of SAI practices.
- Capturing farmers' knowledge of and attitudes towards SAI for learning purposes.

The monitoring and evaluation framework can evolve over time using the experiences gained during the implementation of project activities and should incorporate digital tools for monitoring and ex ante analysis of the impacts of SAI practices. The framework should be easy to operate so that project partners are able to collect and document the necessary data from the selected progress indicators. Protocols for documenting data from the indicators should be standardized at the onset of projects. Data recording for the different project components should be regularly monitored during the life cycle of the project. Regular updates can be implemented at project level, with project leaders ensuring that data are recorded consistently. Additionally, the monitoring and evaluation framework should incorporate feedback mechanisms to increase the interaction of stakeholders and increase the chances of SAI uptake; this was strongly felt to be a necessity in the Agriculture Recovery Project in Angola.

Develop a communication strategy for policy engagement: Different stakeholders including governments, smallholder farmers, research and extension services, and the private sector play important roles in implementing agriculture development projects. The communication strategy should therefore consider the different stakeholder groups and the messages that need to be delivered to each. The lessons learned from the implementation of SAI practices should be documented and policy messages developed on how to improve country-level promotion and uptake. Policy briefs should be developed in the project to influence policy dialogue.

Exit and sustainability: Projects should promote SAI for an initial determined period to allow support systems to be developed and farmers to grasp SAI concepts, after which the project should gradually reduce direct financial support. The projects continue to monitor if the support systems in place for SAI practices to continue with minimal project support while providing backstopping where needed until the support systems remain functional. Facilitating active participation of relevant government ministries/departments and the private sector during projects will ensure future sustainability and provide clear handover processes.

EXAMPLE OF SUSTAINING SEED MULTIPLICATION GROUPS FOR IMPROVED SEED

- Identify and train seed multiplication groups in the first year of the project
- Support seed services to produce basic seed for multiplication
- Develop links between the research and farmer groups and seed companies
- Gradually withdraw support (procurement of basic seed for farmers, paying for inspections)
- Farmers begin to pay for inspection on their own
- Farmers can access seed markets from the seed houses through the project
- Relationship building between seed multipliers, research and seed houses happens before the project is completed

IFAD POLICY MESSAGES FOR SAI PROMOTION/LESSONS LEARNED

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1. Increase farmers' access to extension services and other effective learning methods: A public extension system complemented by private sector extension service providers and digital extension services is key to increasing SAI uptake in the smallholder farming sector. In addition, integrating easily accessible extension services with output market linkages further enhances adoption of SAI practices.

WHAT CAN IFAD DO TO IMPROVE EXTENSION SERVICE PROVISION?

- Engage policy providers on the need to adequately finance extension services to support the SAI agenda. IFAD should also position itself to engage governments on the role of pluralistic extension services and provide guidance on the role of the government in creating an enabling environment for pluralism in extension.
- Build the capacity of public extension staff and integrate private extension providers, including providers of private extension services, into SAI-focused projects.
- Promote the development of partnerships with private extension providers that can complement public extension systems in loan projects.

2. Develop input and output markets: Timely input supply to smallholder farmers promotes SAI uptake. An efficient input supply system involves partnerships between governments and private sector stakeholders, including microfinance/credit institutions. Linking smallholder farmers to national, regional and international output markets for high-value crops incentivizes smallholder farmers to adopt SAI practices.

A value chain approach to project design is required to address the production (inputs, knowledge, finance) and output (post-harvest, market linkages) stages in the smallholder sector and therefore enhance uptake of SAI practices. In countries where the private sector is still not developed, evidence-based policy briefs on the benefits of such partnerships will be useful. The case studies in this document provide such evidence (see annex 3).

3. Lobby for reformed input subsidy schemes to be more context-specific and be informed by area-specific recommendations from research.

Government policies related to SAI, such as input subsidies and pesticide use policies, may hamper efforts to promote SAI. In some countries, fertilizer policies are not implemented with an understanding of the context of supported smallholder farmers, but, rather, through blanket recommendations or supply of the same types of inputs that perpetuate mono-cropping and unsustainable use of external inputs through input subsidies. IFAD should be in a position to offer best-bet technologies for/evidence-based advice on the promotion of specific SAI practices through policy briefs. For example, research outputs from national agricultural research institutes and CGIAR centres should be used to derive region- and area-specific recommendations. At project level, technical support for extension staff on sustainable use of inputs should be a priority and should include partnerships with research institutes that use and build capacity on such technologies.

CONCLUSION

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IFAD loan and grant projects have implemented a range of SAI practices to address the inherent biophysical, socio-economic, climate and environmental challenges facing smallholder agriculture in the ESA region. Based on the loan projects, the major drivers of SAI uptake are access to extension services, access to input and output markets, access to technologies, the relevance of SAI practices to the local agroecological conditions and socio-economic situation, and the resilience of farmers to climate and market shocks, which enables farmers to re-invest in SAI. These enablers should be the key focus areas on the agenda to drive productivity, conservation and sustainable use of biodiversity and to improve nutrition in the region through capacity development, private sector involvement, a value chain approach to project design and implementation, and the establishment of strong monitoring and evaluation systems to provide evidence for policy. Policy engagement around access to extension services, access to inputs, input subsidies, access to output markets and private sector engagement will be key to providing an environment conducive to implementing SAI practices.

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ANNEXES

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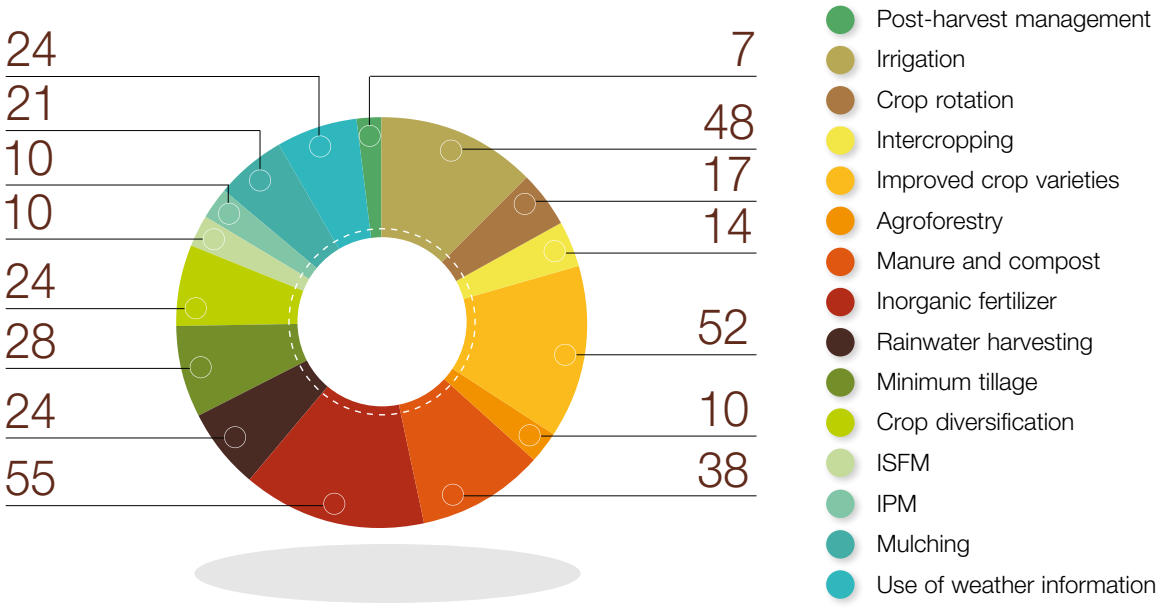
ANNEX 1:

SAI PRACTICES PROMOTED IN ESA

The assessment found significant impacts of SAI on productivity. Figure 2 shows crop-focused SAI practices, and more details of productivity changes are provided in **annex 8**. The example of Madagascar (**case study 1**) shows the impacts of SAI on rice producers. In this case, access to irrigation, promotion of the system of rice intensification, improved cold-tolerant rice varieties and improved soil fertility management practices were major drivers of increased productivity.

FIGURE 2. PREVALENCE (%) OF CROP-FOCUSED SAI PRACTICES PROMOTED BY LOAN PROJECTS

FARM SCALE SAI PRACTICES (CROPS)



CASE STUDY 1

CROP INTENSIFICATION USING SAI PRACTICES: THE CASE OF RICE PRODUCTION IN MADAGASCAR

(EXTRACTED FROM AD2M – NUMBER 2000000850)

The Project to Support Development in the Menabe and Melaky Regions (AD2M) sought to improve the well-being of marginalized smallholder farmers by using irrigation. The project was implemented from 2007 to 2015 in five districts spread across two regions. Farmers in that part of the country still use traditional practices, and low crop yields and environmental degradation are common. Although the system of rice intensification is already adapted to the conditions of western Madagascar, smallholder farmers do not use it because of erratic rainfall patterns. Additionally, the slash and burn system is used in some communities and promotes extensification. The AD2M project introduced irrigation coupled with other SAI practices to increase crop productivity and improve livelihoods. The SAI practices promoted included row planting, soil fertility management using inorganic fertilizer, improved crop varieties, timely planting, mechanizing rice planting and establishing optimum crop density. Rice was planted in multiple rows using planters adapted to the intensification system. In addition, 5,588 ha were put under irrigation, and a 25 per cent rice yield increase was achieved through systems intensification compared with traditional farming practices. Annual income gains from irrigated crop sales increased by 16 per cent and food insecurity decreased by 11 per cent due to the project interventions. Smallholder farmers also spoke about the impact of the AD2M project: “Since the AD2M came, we learned about land maintenance, which we did not do before, and so we took better care of our rice cropping. And our harvests increased as a result.” Row planting of rice left a strong impression on the beneficiary farmers: “This is what really convinced us to adopt the row cropping method, because it was easier to plant the seeds and we could harvest a higher amount.” Despite these successes, lessons were learned that can be incorporated into future programming of similar projects. For the future success of smallholder irrigation schemes, adequate support structures and transparent governance procedures, and clear communication channels at community level, need to be put in place.

SAI practices for increased livestock productivity

In total, 22 loan projects promoted livestock-focused SAI practices. Three projects promoted livestock-based practices only, while eight promoted a combination of crop and livestock productivity enhancing practices. Seven projects focused on practices targeted at increasing livestock and crop productivity, and land management (figure 3).

The most prominent SAI practice that improved livestock productivity was providing high-quality feed through growing forage crops (45 per cent of projects) that were processed into hay and silage (17 per cent) or fed to livestock in situ. Forage grown in cropping systems included forage legumes, grasses and trees. Annual forage legumes such as vetch, *Desmodium, Mucuna, Lablab* and sunn hemp were intercropped with cereals (maize and sorghum), cassava and coffee. In Ethiopia, forage crops were also grown in homestead backyards. Forage trees such as *Calliandra* and *Leucaena*, grasses such as Napier, elephant and oats were grown as pure stands or along crop fields on the farms. Forage legumes and grasses were processed into hay and silage using electric and diesel-powered stover choppers and conserved for dry-season feeding. Projects promoted silage production from maize and sorghum for dairy cattle and goats. With guidance from extension officers and researchers, project beneficiaries formulated their own feed using the forage crops they grew.

Fodder banks for *Lablab*, Napier grass and *Leucaena* were established to ensure that smallholder farmers had a constant supply of seed and planting materials. Nutrition blocks were also promoted to complement fodder/forage. Another feed management practice was the management of grazing and pasture lands to increase plant biomass production, which in turn increased livestock feed availability. For example, in Zambia under the Enhanced Smallholder Livestock Investment Programme (E-SLIP), rangelands were enriched by the planting of legumes such as *Stylosanthes*. In Ethiopia and Eritrea, controlled grazing combining the area enclosure system with the cut and carry system of livestock feeding ensured a constant supply of quality feed and contributed to increasing livestock productivity.

SAI practices also included diversifying livestock species produced on smallholder farms by rearing/introducing improved breeds or through artificial insemination. Improved breeds of cattle (beef and dairy), goats (for meat and milk production), local chickens and pigs were promoted for household consumption and income generation. Value addition and market links for the various livestock species and their products played a critical role in complementing farm-based SAI practices, driving the livestock industry and generating smallholder farmers' income. For example, under the Rwanda Dairy Development Project (RDDP) in Rwanda, diversifying milk products by producing yoghurt, cheese, butter and ghee generated income for smallholder farmers involved in the dairy industry. However, price controls on products such as milk showed the potential of derailing the increased productivity objectives for the livestock enterprise under loan projects. In future projects, the impact of these challenges on SAI uptake needs to be assessed to inform funders and governments. Artificial insemination was promoted to improve breeds of goats and dairy cows to achieve better nutrition and generate more income for household members.

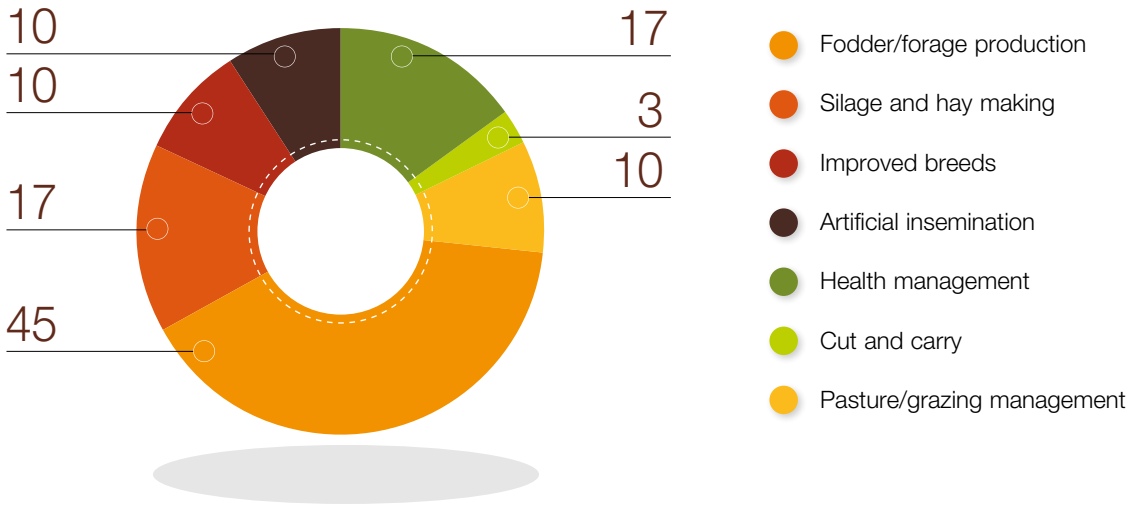
SAI practices also included managing animal health through vaccination and immunization and better animal housing and waste management (e.g. biogas production in SADP). Projects promoted improved animal health through the use of appropriate drugs recommended in each country against common pests and diseases. Vaccination and immunization were important practices for controlling diseases in all livestock species, and spray races were promoted to control ticks. A challenge encountered in the livestock industry was the high cost of commercial feed for poultry and pigs in the SADP project in Lesotho.

Projects also invested in boreholes, cisterns, storage tanks, deep wells and dams to supply water for livestock. Solar pumping was used to supply borehole water to livestock watering points in project communities. Biogas production using manure was integrated into the livestock industry.

Livestock productivity gains were recorded in the dairy sector. Under the SDCP project in Kenya, milk yield increased from 6 to 13 litres/cow/day where silage was used for feeding dairy cows, and feed formulations implemented by smallholder farming communities increased milk yield from 1–5 to 6–15 litres/cow/day (case study 2). Under the Upper Tana Catchment Natural Resource Management Project (UTaNRMP), also in Kenya, goat milk yield increased from 0.25 to 2 litres/goat/day due to improved breeds and the provision of nutritious feed. Under the PROSUL project, the production of red meat increased by 43 per cent due to the provision of forage and improved animal health management.

FIGURE 3. PREVALENCE (%) OF LIVESTOCK-FOCUSED SAI PRACTICES IN THE 29 LOAN PROJECTS IMPLEMENTED IN ESA

FARM SCALE SAI PRACTICES (LIVESTOCK)



Under CGIAR grants (**annex 5**), SAI practices for the livestock industry were promoted by three projects (run by the International Center for Tropical Agriculture [CIAT], the International Livestock Research Institute [ILRI] and its partner the Center for International Forestry Research [CIFOR], and the International Bamboo and Rattan Organization [INBAR]) and focused on use of improved breeds, animal health management and provision of adequate nutritious feed to species adapted for smallholder farming conditions. Artificial insemination was the main procedure used to improve cattle breeds, particularly where farmers were involved in the dairy industry. Animal health management focused on controlling ticks and tick-borne diseases. Intensification of the livestock sector was also achieved through forage production, processing and preservation. Species grown for forage included grasses such as Napier, Rhodes, oats and *Cenchrus*, and legumes, namely *Lablab* and *Mucuna*. *Sesbania sesban*, grown together with crops, was also used as forage, and bamboo also provided feed in Cameroon, Ethiopia, Ghana and Madagascar. Researchers assessed greenhouse gas emissions from the livestock enterprise, and the studies involved appropriate manure management on smallholder farms. The results showed that methane and nitrous oxide emissions from cattle dung on rangelands in Kenya and Tanzania were lower than the 1 kg of methane per head per year and 0.005 kg of nitrous oxide-N per kg N reported by the Intergovernmental Panel on Climate Change (IPCC, 2006). No exact figures on measured greenhouse gas emissions were presented in the ILRI/CIFOR report. Modelling tools were applied to assess the impact of improved fodder quality on greenhouse gas emissions. High-quality fodder with reduced fibre content in feed has the potential to increase climate smartness in livestock production by reducing greenhouse gas emissions (Kadzere, 2018; Notenbaert et al., 2021). Drought-tolerant and improved forage sorghum varieties were developed for the semi-arid environments of ESA.

CASE STUDY 2 SMALLHOLDER DAIRY COMMERCIALIZATION PROGRAMME

(EXTRACTED FROM SDCP – NUMBER 1100001305)

The Smallholder Dairy Commercialization Programme (SDCP) aimed to address constraints in Kenya's smallholder milk sector by increasing smallholders' milk production and productivity and participation in milk markets. The SDCP project met its objectives through training smallholder farmers in dairy groups, offering technical support for household dairy production and developing milk-marketing chains. The programme was implemented in 27 divisions spread across nine counties of Kenya from July 2006 to March 2020. The SAI practices implemented were artificial insemination to increase herd of dairy cows and provided by service providers in communities, rearing improved breeds of dairy cows, and controlling cattle parasites and diseases. Dairy farmers also produced fodder crops (Napier and Rhodes grasses, vetch, oats) that were grown in rotation and intercropping cropping systems with maize and sorghum on the farm. Manure produced by dairy cows was used for improving soil fertility in cropping systems where fodder and food crops were grown. The manure was also used for producing biogas to meet household energy needs. Maize and sorghum were also grown for silage, which was fed to dairy cows. The SAI practices were promoted through field days and commodity producer groups in the 27 selected divisions.

The programme reached 120,000 beneficiaries; 60 per cent of whom were female, and 13,132 were smallholder dairy farmers. Eight milk processing facilities, 500 fodder bulking centres and 27 community based artificial insemination schemes were established across the 27 divisions hosting the programme. Youth participation was 19 per cent, against a 10 per cent target, and young people were involved as milk traders. The uptake of improved livestock feeding techniques and vaccination of animals increased by 8 per cent and 25 per cent, respectively, among beneficiaries compared with non-beneficiaries. Milk yield increased from 1–5 to 6–15 litres/day/cow as a result of feeding dairy cows with hay and silage and managing animal health. The total milk production achieved was 197,232,391 litres, against a target of 205,807,391 litres. Beneficiary dairy farmers produced 37 per cent more milk in total than non-beneficiaries. The SDCP demonstrated the importance of the private sector in creating market linkages for smallholder farmers. Coupled with smallholder farmer training on new skills and knowledge, partnership with the private sector is instrumental to the future development of the smallholder dairy sector in Kenya and other ESA countries.

SAI practices for increased fish productivity

Aquaculture complements crops and livestock in addressing the food, nutrition and income security of smallholder farmers (FAO, 1999). Nine loan projects promoted aquaculture and marine and inland fishery systems (**annex 4**). The SAI practices implemented included growing high-quality adapted fish species, multiplying fingerlings/fish seed using hatcheries, providing nutritious commercial feed, developing supplementary fish feed using insects (termites, earthworms, black soldier flies) and diversifying fish species (catfish, tilapia, carp). The practices also included improved fish handling using cooler boxes, improved sanitation, use of pond liners and predator nets, use of motorized fishing boats and improved methods of catching and harvesting selected fish species, and strengthening input

supply systems for aquaculture. Earthen ponds and cage systems were promoted to control fish feeding and manage fish populations. Fish preservation methods such as drying racks, solar drying and smoking kilns were promoted to maintain fish quality. Value addition in different fish products (fish oil, fish snacks, fish sauce, pickled fish, salt-pressed fish) was promoted. Managing mangroves through afforestation and protecting inland water sources contributed towards increasing the productivity of the fishing enterprise. Halophytes such as *Casuarina equisetifolia* were used for the afforestation of mangroves, which provided a water environment for fish production. Additionally, inland water bodies used for fish production were protected by soil management techniques implemented around dams and ponds. In Mozambique, fish production was integrated with crop and livestock production, and the Small-scale Aquaculture Development Project (PRODAPE) focused on rehabilitating aquaculture systems in rural communities destroyed by Cyclone Idai. The SAI practices promoted increased fish productivity and production (**case study 3**).

CASE STUDY 3 IMPACT OF SAI PRACTICES ON THE FISHERIES INDUSTRY

Three loan projects reported fish production and productivity data. Under the Aqaculture Business Development Programme (ABDP) in Kenya, 176,586 kg of fish were harvested from 4,639 ponds, or the equivalent to 38 kg of fish from each pond. Under the Fisheries Resources Management Programme (FReMP) in Eritrea, 350 tonnes of fish were harvested from 70 inland dams, and the fish yield averaged 5 tonnes/dam/year. Under the Sofala Bank Artisanal Fisheries Project (PPABAS) in Mozambique, 55,000 tonnes of fish were harvested from inland water resources and 218,000 tonnes from the sea. The three loan projects did not report the baseline fish production and productivity levels before the introduction of SAI interventions.

Under the grant projects, aquaculture research led by World Fish centred on developing new and improved fish strains that can be grown in ESA as well as in South-East Asia. Biotechnology using molecular markers was applied in the research, and a yield gap analysis for fish species such as tilapia was conducted. A yield gap analysis under the World Fish-led project in tilapia farming systems revealed the importance of good management, including temperature and oxygen regulation, in increasing the production of tilapia. In Kenya, research into the impact of high-quality commercial fish feed was conducted and it revealed increased production due to improved feeding.

ANNEX 2:

THE ROLE OF RESEARCH GRANTS IN GENERATING INNOVATION

A review of the SAI practices promoted through grants (**annex 5**) has shown that some practices generated through research are promoted through loan projects. These practices include improved crop varieties, ISFM, minimum tillage, fodder production and the mechanization of farm operations. However, there has been no clear link between technology generated from CGIAR grants and its design or integration in loan projects. For example, none of the projects in Rwanda and Zambia promoted wheat, yet both countries had been given a grant supporting wheat research. Some technologies, such as the use of bamboo as fodder, have not been used in IFAD loan projects. The grant project led by INBAR demonstrated the multiple benefits of bamboo agroforestry in smallholder farming systems at farm and landscape scales.

ANNEX 3:

DRIVERS OF AND CONSTRAINTS ON SAI PRACTICE UPTAKE (CASE STUDIES)

Improved knowledge of and access to extension services

CASE STUDY 4

INCREASING ACCESS TO EXTENSION SERVICES AND MARKETS IN ZAMBIA

(EXTRACTED FROM S3P – NUMBER 1100001567)

The Smallholder Productivity Promotion Programme (S3P) was implemented in Luapula Province, Muchinga Province and the Northern Province of Zambia by the Ministry of Agriculture from 2013 to 2019. The goal of the programme was to "sustainably improve the income levels, food and nutrition security of poor agricultural households in the programme area." The development objective of the S3P was to achieve "sustainable increase in agricultural production, productivity and sales of smallholder farmers in the operational areas." During its initial stages, the project faced numerous challenges in reaching milestones due to an understaffed public extension system and limited knowledge of new CSA practices. Two service providers, Community Markets for Conservation (COMACO) and Total LandCare, were recruited to promote conservation agriculture and COMACO also provided a market for farmers. Through the activities facilitated by COMACO and Total LandCare, the adoption of SAI averaged 34 per cent by the end of the project and the project exceeded outreach targets. To further enhance the adoption of SAI, COMACO paid a premium to farmers who produced their crops using SAI techniques, in this case conservation agriculture. Improved physical access due to revamped road network, access to market information and agribusiness advisories empowered farmers and transformed smallholder agriculture in target communities. This partnership had an 81 per cent achievement, which was attributed to active participation of farmers in producer farmer groups. Overall, 45 per cent female representation was achieved during the S3P project implementation. Through infrastructure development, 1,104 households benefited from the project and increased farmer access to training and produce bulking centres. Market access increased by 10 per cent for beneficiaries and income from crop sales went up by 39 per cent compared with non-beneficiaries. About 12,150 households increased marketed cassava, beans and rice quantities by at least 20 per cent as a result of S3P project interventions. Increased smallholder farmer access to extension services and market linkages are crucial and require a combination of interventions adapted to the prevailing conditions of the target communities.

Active community participation and relevance of SAI: Among programmes promoting a bottom-up approach to SAI promotion, the uptake of SAI practices was quite good. The NAP, SADP, UTaNRMP and PASIDP II projects promoted active participatory approaches whereby farmers were closely involved in selecting and applying SAI practices, which contributed towards successful implementation. As a result, beneficiary farmers achieved crop productivity and economic and social gains from the application of SAI practices in their farming system (**case study 5**).

CASE STUDY 5

PARTICIPATORY IRRIGATION DEVELOPMENT IN THE SMALLHOLDER SECTOR OF ETHIOPIA

(EXTRACTED FROM PASIDP II – GRANT NUMBER 20001134)

The Participatory Small-scale Irrigation Development Programme (PASIDP) was implemented to improve the food security, family nutrition and income of poor rural households living in drought-prone and food-deficit areas in four regions of Ethiopia. Phase 1 of the project was implemented from 2008 to 2015, and phase 2 was implemented from 2016 to 2024. Small-scale irrigated agriculture was promoted as a way of improving the livelihoods of smallholder farmers. The project integrated crop and livestock with land management SAI practices in smallholder farming communities. The practices implemented in addition to irrigation included conservation agriculture (minimum tillage, crop residue cover, rotation), ISFM (composting, inorganic fertilizers), improved crop varieties, agroforestry, and soil and water conservation (contour bunding, trenches, percolation pits, microbasins, eyebrow basins). Irrigation water was supplied using drip systems, solar pumping from shallow wells and ponds, lift pumps and drag hose.

Farmers participated in irrigation schemes through research extension groups, cooperatives and market alliances. Farmers also participated in and influenced project activities by being members of irrigation water users' associations. In addition, farmers were involved in selecting the soil and water management technologies applied on the upstream of irrigation schemes to protect the schemes. Upstream water management ensured that farmers got an adequate supply of irrigation water on time throughout cropping cycles. Beneficiary farmers received technical training, participated in learning exchanges, and accessed inputs and other services from the farmer service centres established by the project. Training and access to inputs enabled beneficiary farmers to apply SAI practices such as irrigation, improved crop varieties, ISFM and conservation agriculture. As members of research extension groups and cooperatives, farmers were involved in farmer-to-farmer extension and SAI information dissemination in the project and spill-over communities. The project reached 311,000 beneficiaries and created 175 irrigation water users' associations in targeted rural communities. As part of capacity-building, 35,720 women received training facilitated by the project and 12,000 ha of land was put under irrigation. During the dry season, farmers achieved a 51 per cent crop yield gain due to irrigation complemented by good agricultural practices compared with non-beneficiary farmers. In addition, beneficiary farmers' market participation with irrigated crops rose to 175 per cent and crop sales revenue increased to 213 per cent compared with non-beneficiaries. Irrigation also triggered crop diversification as beneficiary farmers grew pulses, cereals, vegetables and fruit. Beneficiary households also increased acquisition of family assets by 22 per cent more than the control group. Irrigation combined with other SAI practices also made beneficiary households more resilient during drought periods. When combined with other SAI practices and market incentives, irrigation offers a pathway for increasing crop productivity and the total production of various crops important to the livelihoods of smallholder farming communities in Ethiopia and similar environments.

Access to inputs

CASE STUDY 6

ACCESS TO INPUTS AS A DRIVER OF SAI UPTAKE: THE CASE OF KCEP-CRAL IN KENYA

The Kenya Cereal Enhancement Programme – Climate Resilient Agricultural Livelihoods Window (KCEP-CRAL) is a strategic partnership between the Government of Kenya, the European Union and the Rome-based Agencies funded jointly by the Government of Kenya, the European Union, IFAD, the Adaptation for Smallholder Agriculture Programme, participating financial institutions and beneficiaries. The programme contributes to national food security and is implemented through a value chain and nutrition sensitive approach aimed at supporting smallholder farmers to increase their production and the productivity and profitability of the targeted value chains.

The programme provides access to inputs and/or technological packages, such as conservation agriculture services, insurance and post-harvest equipment, through an e-voucher facilitated through a public–private–producer partnership. In the first few years of the scheme, farmers pay 10 per cent of the costs of the input voucher and gradually increase their contribution in subsequent years. Through the e-voucher, a total of 107,626 (77 per cent of the project target) farmers accessed improved inputs at various levels, "thus being enabled to apply SAI in their farms." Significant yield increases have been achieved of up to 179 per cent for maize in arid and semi-arid lands, 55 per cent for sorghum and 29 per cent for pulses.

Although the e-voucher promotes improved inputs, the contribution of farmers to the whole input package has been a challenge. So what has the project done? On the one hand, the programme has provided a mechanism that allows farmers to choose e-voucher the inputs and services that are critical for their needs and that they can afford.

PRELNOR and SAPP, on the other hand, promote access through seed business development. Seed businesses are linked with research services for certification and are encouraged to run seed production as a business through linkages with agrodealer networks and seed fairs. In this way, local farmers are able to access improved inputs at reasonable costs.

Access to output markets

CASE STUDY 7

EXPORT-DRIVEN VALUE CHAINS AS A KEY INCENTIVE FOR SAI PRACTICE UPTAKE: THE CASE OF THE PRICE PROJECT IN RWANDA

(EXTRACTED FROM PRICE – NUMBER 110000155)

The Project for Rural Income through Exports (PRICE) in Rwanda was designed to achieve sustainable and increased returns to smallholder farmers from export-driven value chains. The project was implemented from 20 December 2011 to 31 December 2020 across the whole country. PRICE linked smallholder farmers with and increased their participation in export-driven value chains in Rwanda. High-value horticultural crops (e.g. onions, tomatoes) and tea and coffee were the commodities targeted because of the availability of international (e.g. Europe) and regional (e.g. Burundi, Uganda, and Democratic Republic of the Congo) output markets. Farmer producer cooperatives were empowered so that they had bargaining power with farm gate producer prices of vegetables, tea and coffee. Producer cooperatives were also empowered so that they became equal partners with the private sector actors involved in developing smallholder agriculture and driving rural economies. The long-term goal was to increase the volumes of high-value crops getting to output markets and the economic returns for smallholder farming households. The SAI practices applied were improved crop varieties, intercropping in coffee and tea systems, optimum inorganic fertilizer use, and integrated pest management (IPM). In addition, in-class technical training and FFSs improved knowledge and skills among the participating households. Taking farming as a business through new models such as out grower schemes and innovative financing methods (e.g. the Horticulture Export Guarantee Facility) increased farmers' participation in the targeted value chains.

The SAI interventions had reached 142,296 households, 98 per cent of the target, by the end of the project. Coffee income had increased by 32 per cent and horticulture income by 93 per cent per year compared with non-beneficiaries. The proportion of women included in the project was 38 per cent against a 46 per cent target. One of the key contributors to the increase in crop volumes and produce quality was the use of SAI practices in the production of horticultural crops, coffee and tea. Farmer cooperatives using project interventions became popular produce aggregation actors, and farmers got higher selling prices for their produce than non-beneficiaries. For example, all coffee was delivered to aggregation centres run by project cooperatives because of better prices. Horticulture farmers using PRICE interventions acquired more household and productive assets than non-beneficiaries. Another major impact of PRICE was that non-beneficiary farmers began to finance their own businesses using personal savings and external sources. At the household level, beneficiaries exhibited more resilience to hazards such as drought than non-beneficiaries. Young people were empowered, and their participation in the coffee value chain increased household income by 7 per cent compared with non-beneficiary groups. Job creation in the project communities increased 1.6 times in the horticulture value chains and 1.4 times in the coffee value chains where SAI practices were applied. Overall, PRICE had a positive impact on farmer empowerment and income generation in the smallholder farming sector of Rwanda. The approaches used in PRICE provide important lessons for future projects in ESA.

ANNEX 4:

LIST OF LOAN PROJECTS REVIEWED IN ESA

LIST OF LOAN PROJECTS REVIEWED IN ESA

COUNTRY	LOAN PROJECT CODE	STAGE OF PROJECT (PRE OR POST MTR OR COMPLETED)	IMPLEMENTATION PERIOD
Angola	ARP	Completed	2017-2022
	AFAP	Completed	2015-2022
Botswana	ASSP	Completed	2010-2018
Burundi	PAIVA-B	Completed	2009-2019
	PRODEFI II	Completed	2015-2021
	PNSADR-IM	Ongoing, post MTR	2014-2022
Comoros	PREFER	Ongoing, post MTR	2017-2022
Eritrea	NAP	Completed	2012-2021
	FReMP	Ongoing, post MTR	2016-2023
Eswatini	SMLP	Ongoing, post MTR	2015-2023
Ethiopia	PASIDP II	Ongoing, post MTR	2016-2024
	CBINReMP	Completed	2009-2018
Kenya	ABDP	Ongoing, pre MTR	2017-2026
	SDCP	Completed	2005-2019
	KCEP-CRAL	Ongoing, post MTR	2015-2022
	UTaNRMP	Ongoing, post MTR	2012-2022
Lesotho	SADP	Completed	2011-2020

LIST OF LOAN PROJECTS REVIEWED IN ESA

COUNTRY	LOAN PROJECT CODE	STAGE OF PROJECT (PRE OR POST MTR OR COMPLETED)	IMPLEMENTATION PERIOD
Madagascar	AD2M phase 2	Ongoing, post MTR	2015-2023
	FORMAPROD	Ongoing, post MTR	2012-2023
Malawi	SAPP	Ongoing, post MTR	2011-2023
	PRIDE	Ongoing, post MTR	2015-2024
Mozambique	PROSUL	Completed	2012-2020
	PRODAPE	Ongoing, pre MTR	2019-2026
	PPABAS	Completed	2010-2019
Rwanda	RDDP	Ongoing, post MTR	2016-2022
	PASP	Completed	2013-2020
	PRICE	Completed	2011-2020
Tanzania	AFDP	Ongoing, pre MTR	2020-2027
Uganda	ATAAS	Completed	2010-2018
	VODP2	Completed	2010-2019
	PRELNOR	Ongoing, post MTR	2014-2023
Zambia	S3P	Completed	2011-2019
	E-SLIP	Ongoing, post MTR	2014-2022
Zimbabwe	SIRP	Ongoing, post MTR	2016-2023

ANNEX 5:

GRANT PROJECTS IMPLEMENTED IN ESA AND REVIEWED

GRANT PROJECTS IMPLEMENTED IN ESA AND REVIEWED

COUNTRIES	CGIAR CENTRE	GRANT PROJECT NAME	STAGE OF PROJECT AND DATES OF IMPLEMENTATION
Ghana, Senegal, Uganda	Africa Rice	Enhancing institutional breeding capacity to develop climate-resilient crops for African smallholder farmers in Ghana, Senegal and Uganda	Closing, 2018-2022
United Republic of Tanzania, Rwanda	CIAT	Climate-smart crop-livestock systems through improved forages and feeding strategies: enhancing productivity and adaptive capacity while mitigating greehouse gas (GHG) emissions in East Africa	Completed, 2016-2022
Rwanda, Zambia	International Maize and Wheat Improvement Centre	Enhancing smallholder wheat productivity and competitiveness to reduce wheat Import ills in Rwanda and Zambia	Completed, 2016-2021
Burundi, Rwanda	International Institute of Tropical Agriculture	Fight cassava brown streak disease and cassava mosaic disease through the deployment and adaptation of new resistant germplasm and clean seed in Burundi and Rwanda	Completed, 2017-2020

GRANT PROJECTS IMPLEMENTED IN ESA AND REVIEWED

COUNTRIES	CGIAR CENTRE	GRANT PROJECT NAME	STAGE OF PROJECT AND DATES OF IMPLEMENTATION
Ethiopia, Uganda	World Agroforestry Centre/International Centre for Research in Agroforestry	Agro-biodiversity and landscape restoration for food security and nutrition in Eastern Africa	Completed, 2016-2019
Kenya, United Republic of Tanzania	International Crops Research Institute for the Semi-Arid Tropics	Strengthening sorghum and millet value chains for food, nutritional and income security in arid and semi-arid lands of Kenya and United Republic of Tanzania (SOMNI)	Completed, 2016-2020
Ethiopia, South Sudan	ICBA	Rehabilitation and management of salt-affected soils to improve agricultural productivity in Ethiopia and South Sudan	Completed, 2018-2022
Kenya, United Republic of Tanzania	ILRI/CIFOR	Greening livestock: incentive-based interventions for reducing the climate impact of livestock production in East Africa	Completed, 2017-2019
Cameroon, Ethiopia, Ghana, Madagascar	INBAR	Inter-Africa Bamboo Smallholder Farmers Livelihood Development Programme	Closing, 2016-2022
United Republic of Tanzania, Rwanda	World Fish	Improving the technological foundations for sustainable aquaculture	Completed, 2016-2019

ANNEX 6:

IMPACT ASSESSMENT REPORTS REVIEWED

IMPACT ASSESSMENT REPORTS REVIEWED

GRANT NUMBER	TITLE	STATUS
20001134	Participatory Small Irrigation Development Programme I (PASIDP I)	**Completed:** Garbero, A. and Chichaibelu, B. B. 2018. *Impact Assessment Report: Participatory Small Irrigation Development Programme I, Ethiopia.* Rome: IFAD
1100001305	Impact evaluation of the smallholder dairy commercialization programme in Kenya (SDCP)	**Completed:** Bonilla, J., McCarthy, N., Mugatha, S., Rai, N., Coombes, A. and Brubaker, J. 2017. *Impact Evaluation of the Smallholder Dairy Commercialization Programme in Kenya.* New Delhi: International Initiative for Impact Evaluation
2000000850	Impact evaluation of the programme supporting development of Menabe and Melaky regions in Madagascar (AD2M)	**Completed:** Ring, H., Morey, M., Kavanagh, E., Kamto, K., McCarthy, N., Brubaker, J. and Rakotondrafara, C. 2017. *Impact Evaluation of the Programme Supporting Development of Menabe and Melaky Regions in Madagascar.* New Delhi: International Initiative for Impact Evaluation
1100001550	Project for Rural Income through Exports (PRICE)	**Completed:** Mabiso, A., Abouaziza, M., Wood, B. D. K. and Balint, T. 2018. *Project for Rural Income through Exports (PRICE), Rwanda: Impact Assessment Report.* Rome: IFAD
1100001567	Smallholder Productivity Promotion Programme (S3P)	**Completed:** Arslan, A., Zucchini, E. and Scheiterle, L. 2021. *Impact Assessment Report: Smallholder Productivity Promotion Programme, Zambia.* Rome: IFAD

IMPACT ASSESSMENT REPORTS REVIEWED

GRANT NUMBER	TITLE	STATUS
1100001530	Smallholder Agriculture Development Project (SADP)	**Completed:** Mabiso, A., Hossain, M. and Toguem, H. R. 2020. *Smallholder Agriculture Development Project (SADP), Kingdom of Lesotho: Impact Assessment Report.* Rome: IFAD
1100001534	Sustainable Agricultural Production Programme (SAPP)	**Draft:** Cavatassi, R. and Maggio, G. 2022. *Impact Assessment Report: Sustainable Agricultural Production Programme, Malawi*. Rome: IFAD
1100001618	Pro-Poor Value Chain Development Project in the Maputo and Limpopo Corridors (PROSUL)	**Draft:** Arslan, A., Cavatassi, R., Gemessa, S., Maggio, G. and Scheiterle, L. 2021. *Impact Assessment Report: Pro-Poor Value Chain Development Project in the Maputo and Limpopo Corridors (PROSUL), Mozambique.* Rome: IFAD

ANNEX 7:

SAI PRACTICES FOR LOAN PROJECTS

SAI PRACTICES FOR LOAN PROJECTS

COUNTRY	LOAN PROJECT	ENTERPRISE FOCUS	SAI PRACTICES PROMOTED
Angola	Agricultural Recovery Project (ARP)	Crop/livestock production	Minimum tillage, soil fertility management using inorganic fertilizer, intercropping, irrigation technologies, drought-tolerant crops, fodder production
	Artisanal Fisheries and Aquaculture Project (AFAP)	Fisheries	Fingerlings multiplication in hatcheries, improved commercial fish feed, improved ponds, improved fish harvesting methods to avoid overfishing, improved fish handling using ice and sanitation, fish processing (smoking of fish using kilns), improved waste disposal infrastructure
Botswana	Agricultural Services Support Project (ASSP)	Crop production	Minimum tillage (using no-till planters, furrow rippers), soil testing for fertilizer recommendation, mechanization, irrigation, pesticides for pest control, herbicides for weed control
Burundi	Agricultural Intensification and Value-enhancing Support Project (PAIVA-B)	Crop/livestock production/land management	Improved crop varieties (beans, maize, rice), seed multiplication, disease-free planting materials for potato, cassava and banana; manuring, irrigation, agroforestry, fodder production, improved dairy, soil erosion control
	Value Chain Development Programme Phase II (PRODEFI II)	Crop/livestock/fish production	Improved crop varieties (beans), agroforestry, land levelling, disease-free planting materials (cuttings and suckers), improved livestock breeds, fodder production, use of weather warning systems

SAI PRACTICES FOR LOAN PROJECTS

COUNTRY	LOAN PROJECT	ENTERPRISE FOCUS	SAI PRACTICES PROMOTED
Burundi	National Programme for Food Security and Rural Development in Imbo and Moso (PNSADR-IM)	Crop/livestock/fish production	Biotechnology for banana production, seed multiplication, post-harvest mechanization and storage, artificial insemination, immunization of livestock
Comoros	Family Farming Productivity and Resilience Support Project (PREFER)	Crop/livestock production/land management	Disease-free cuttings (cassava) and suckers (bananas), improved crop varieties, soil fertility management using inorganic fertilizer, livestock manure, composting, irrigation, crop diversification (cassava, bananas, horticulture)
Eritrea	National Agriculture Project (NAP)	Crop/livestock production/land management	Improved crop varieties (for legumes, potatoes), row planting, early planting, intercropping, composting, inorganic fertilizer use, crop protection using pesticides, irrigation (pressurized and semi-pressurized systems), rainwater harvesting, forage production, improved dairy breeds of cows and goats, animal health management using veterinary drugs, bee-keeping, use of real-time weather information for farmer decision-making
	Fisheries Resources Management Programme (FReMP)	Fisheries/land management	Soil erosion control and rainwater conservation through terracing around water reservoirs, afforestation, reliable agriculture and aquaculture input supply system, fish production intensification (improved breeds, improved fish feed), diversifying fish species (catfish, carp, tilapia), improved fish handling facilities (use of ice in storage systems), value addition (fish oil, fish sauce, fish snacks, fish pickling, salt-pressed fish), mobile fish dryers to preserve fish quality
Eswatini	Smallholder Market-led Project (SMLP)	Crop/livestock production/land management	Irrigation, soil and water conservation, conservation agriculture, rainwater harvesting, mechanized planting, drought-tolerant crops, permaculture, crop diversification, enterprise diversification, fodder production, hay and silage making, use of climate information
Ethiopia	Community-based Integrated Natural Resources Management Project (CBINReMP)	Crop/livestock production/land management	Composting, manure use in backyard gardens, crop diversification (vegetables, fruits, food crops), forage production including grass from cut and carry system implemented on the watershed

SAI PRACTICES FOR LOAN PROJECTS

COUNTRY	LOAN PROJECT	ENTERPRISE FOCUS	SAI PRACTICES PROMOTED
Ethiopia	Participatory Small-scale Irrigation Development Programme Phase II (PASIDP II)	Crop/livestock production/land management	Irrigation (drip, solar pumping, drag-hose) from shallow wells, soil and water conservation, conservation agriculture (minimum tillage, crop residue cover, rotation), mechanization, ISFM (composting, inorganic fertilizers), agroforestry, improved crop varieties, forage production, crop diversification, contour bunding, trenches, percolation pits, microbasins, eyebrow basins
Kenya	Smallholder Dairy Commercialization Programme (SDCP)	Livestock production	Improved dairy cow breeds, artificial insemination, animal health management, fodder production, silage making, hay making and conservation, rotation and intercropping in fodder production systems, soil fertility management using manure
	Upper Tana Catchment Natural Resource Management Project (UTaNRMP)	Crop/livestock production/land management	Soil fertility management using inorganic fertilizer, manure and compost; conservation agriculture practices, drought-tolerant crop varieties, tissue culture for banana production, seed multiplication for improved varieties, rainwater harvesting using tanks and water pans, soil and water conservation, irrigation using borehole water, small dam and shallow wells; solar pumping of irrigation water, fodder production using fodder trees *(Calliandra)* and grasses, improved dairy cow and goat breeds
	Kenya Cereal Enhancement Programme – Climate Resilient Agricultural Livelihoods Window (KCEP-CRAL)	Crop production/land management	Minimum tillage (using ripping and zai pits), drought-tolerant crops and varieties, water harvesting and conservation in the field, ISFM (inorganic fertilizer, manure, compost), chemical pest control, push-pull for pest management
	Aquaculture Business Development Programme (ABDP)	Fisheries	Improved fingerlings, improved commercial fish feed, supplementary fish feed using termites, black soldier flies and earthworms, use of pond liners, use of predator nets

SAI PRACTICES FOR LOAN PROJECTS

COUNTRY	LOAN PROJECT	ENTERPRISE FOCUS	SAI PRACTICES PROMOTED
Lesotho	Smallholder Agriculture Development Project (SADP)	Crop/livestock production	Irrigation, boreholes, inorganic fertilizers, composting, conservation agriculture, improved varieties, open pollinated crop varieties, early planting, water harvesting, protective shade nets for horticulture, mechanization of post-harvest processing, use of climate information, controlled grazing, participatory rangeland management, improved livestock breeds, animal health management.
Madagascar	Vocational Training and Agricultural Productivity Improvement Programme (FORMAPROD)	Crop/livestock production	Agroforestry, crop rotation, soil fertility management using inorganic fertilizer, compost and vermicompost; mulching, drought-tolerant crop varieties, irrigation, contour cropping, animal health management, fodder production using cactus
	Project to Support Development in the Menabe and Melaky Regions – Phase II (AD2M-II)	Crop/livestock/fish production	Irrigation (flood), improved crop varieties (cassava, beans, horticulture and rice), mechanization (rice planting), crop diversification (cassava, beans, rice, onions, tomatoes, peanuts)
Malawi	Sustainable Agricultural Production Programme (SAPP)	Crop/livestock production	Minimum tillage (through dibble stick, basins, ripping, crop residues, intercropping), double row cropping for legumes, double up legumes, soil fertility management using blended and straight inorganic fertilizers, improved legume seed production, improved crop varieties, agroforestry, box ridges, contour ridges
	Programme for Rural Irrigation Development (PRIDE)	Crop production/ land management	Biofertilizers for legumes, push-pull for pest management, manure, straight and blended inorganic fertilizer, improved crop varieties, irrigation for high-value crops, conservation agriculture (dibble stick, basins, ripping, crop residues, intercropping)

SAI PRACTICES FOR LOAN PROJECTS

COUNTRY	LOAN PROJECT	ENTERPRISE FOCUS	SAI PRACTICES PROMOTED
Mozambique	Pro-Poor Value Chain Development Project in the Maputo and Limpopo Corridors (PROSUL)	Crop/livestock production	Irrigation (drip system), crop rotation, intercropping, mulching, improved crop varieties, disease-free cuttings for cassava, shade nets to protect horticultural crops, IPM (pesticides and push-pull), forage production, hay and silage making, livestock nutrition blocks, input start-up kits, soil fertility management using fertilizer, weed management, crop diversification (cassava, beans, potatoes, horticulture, forage), linking farmers to markets
	Small-scale Aquaculture Development Project (PRODAPE)	Fisheries	Fingerlings multiplication in hatcheries, improved commercial fish feed, earthen ponds, cage system for managing fish feed and populations, establishing fish distribution networks, rehabilitating fish systems damaged by Cyclone Idai
Rwanda	Rwanda Dairy Development Project (RDDP)	Livestock production	Mechanization of stover chopping, forage production (legumes, grasses, trees), agroforestry, artificial insemination, animal health management (spraying, vaccination), rainwater harvesting, soil fertility management using compost and manure, manure use and management through biogas production
	Climate-Resilient Post-Harvest and Agribusiness Support Project (PASP)	Crop/livestock production	Drought-tolerant early maturity crops and varieties (e.g. maize), soil fertility management using compost and manure, disease-free cassava and Irish potato cuttings, rainwater harvesting by tanks to clean dairy facilities, forage production, hay and silage making, weather information, post-harvest storage using hermetic bags and tarpaulins
	Project for Rural Income through Exports (PRICE)	Crop production	Soil and leaf analysis for soil fertility management, optimal fertilization using inorganic fertilizers, improved crop varieties, intercropping, soil erosion control, IPM, crop diversification (fruit, bananas, coffee, tea, horticulture)
United Republic of Tanzania	Agriculture and Fisheries Development Programme (AFDP)	Crop production/ fisheries	Improved crop varieties, high-quality fingerlings (tilapia, catfish), improved fish-catching methods, use of drying racks and solar dryers, ice making, cooler boxes for improved fish handling and storage

SAI PRACTICES FOR LOAN PROJECTS

COUNTRY	LOAN PROJECT	ENTERPRISE FOCUS	SAI PRACTICES PROMOTED
Uganda	Agricultural Technology and Agribusiness Advisory Services Programme (ATAAS)	Crop/livestock production/land management	Improved crop varieties (rice, maize, beans), disease-free cassava cuttings, *Striga*, necrosis- and drought-tolerant maize varieties, cold-tolerant rice varieties, biofortified bean varieties (zinc and iron), mulching, intercropping, rotation, irrigation, forage production (legumes and grasses)
	Project for the Restoration of Livelihoods in the Northern Region (PRELNOR)	Crop production	Row planting in field crops (sesame, sorghum), biofertilizers for legumes, mulching, ISFM using compost and manure, planting basins, improved crop varieties (cassava, rice, maize, beans, soybean), conservation agriculture, IPM including push-pull, mechanization (planters and weeders pulled by tractors), roadside rainwater harvesting, weather information for agro-advisories, disease-free cassava cuttings
	Vegetable Oil Development Project 2 (VODP2)	Crop production	Improved and early maturing crop varieties, crop rotation, soil fertility management using manure and inorganic fertilizer, minimum tillage, mulching, water harvesting, chemical pest and disease management
Zambia	Smallholder Productivity Promotion Programme (S3P)	Crop/livestock production	Conservation agriculture (basins, ripping, dibble stick), drought-tolerant crop varieties, organic farming (including composting), inorganic fertilizer, disease-free cuttings of cassava, seed and cutting multiplication, crop diversification, agroforestry
	Enhanced Smallholder Livestock Investment Programme (E-SLIP)	Livestock production	Rangeland management, rangeland enforcement
Zimbabwe	Smallholder Irrigation Revitalization Programme (SIRP)	Crop/livestock production	Irrigation (flood and overhead systems), CSA, conservation agriculture (including minimum tillage, rotation, intercropping), IPM (including push-pull), mulching, inorganic fertilizer, green manuring, improved drought-tolerant varieties, agroforestry, rainwater harvesting, use of climate information, fodder production, hay and silage making

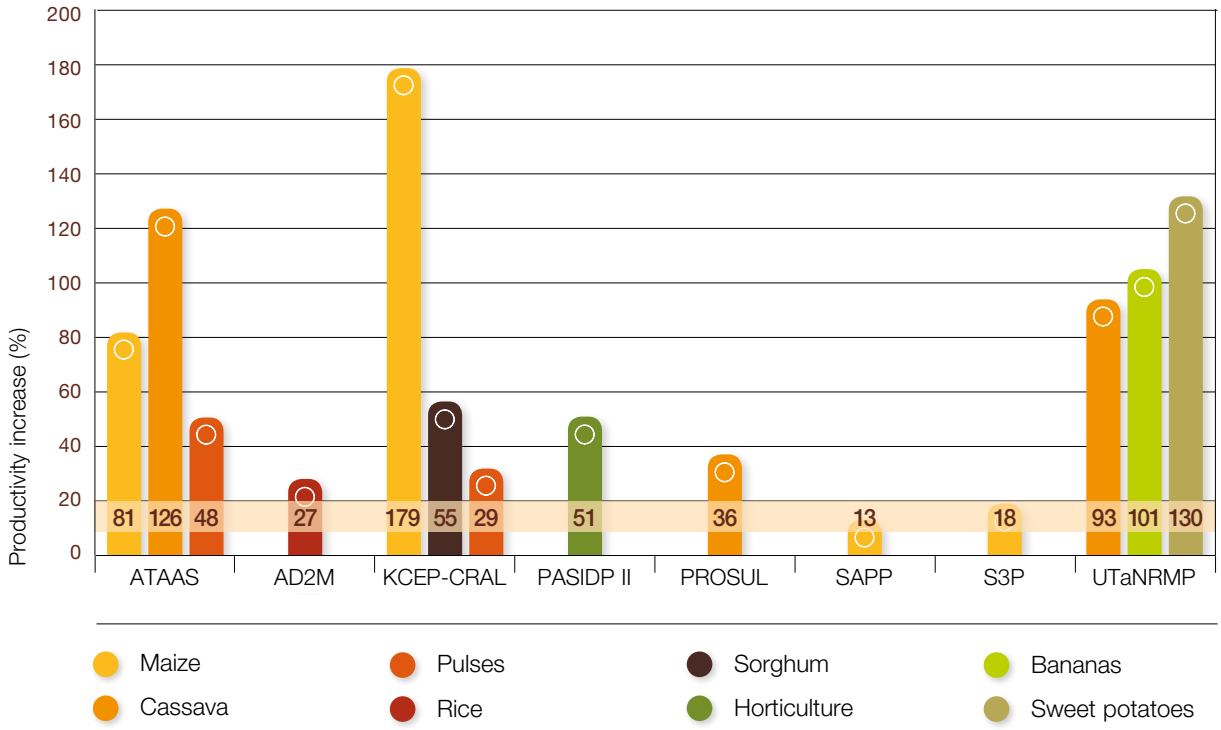
ANNEX 8:

CROP PRODUCTIVITY INCREASES FROM SAI PRACTICES IN ESA UNDER LOAN PROJECTS

This section presents some of the crop and livestock productivity gains reported quantitatively in the project completion and impact assessment reports. Productivity increased by 36 per cent for cassava in Mozambique (PROSUL project) and 25 per cent for rice in Madagascar (AD2M project). Maize productivity increased by 13 per cent in Malawi, 81 per cent in Uganda, 179 per cent in Kenya and 18 per cent in Zambia after SAI practices were implemented (figure 4). Pulses and horticulture increased by 38 per cent and 51 per cent, respectively. In Kenya under the UTaNRMP project, beans, green grams and cowpeas productivity increased from 3 to 8, 3 to 6, and 5 to 8 bags per acre, respectively. In Mozambique, the production of vegetables such as tomatoes increased as a result of using improved varieties, irrigation, inorganic fertilizers, IPM practices and shade nets. The yield of bananas increased, resulting in 101 per cent of the target being achieved by using improved disease-free suckers and good agricultural practices. The graph also shows that better access to improved inputs (in KCEP-CRAL) through the e-voucher enabled farmers to improve productivity, as did improved extension support, and integrating conservation agriculture mechanization services into the e-voucher scheme increased uptake of conservation agriculture.

FIGURE 4. CROP PRODUCTIVITY INCREASE (%) DUE TO SAI PRACTICES IMPLEMENTED AS PART OF LOAN PROJECTS IN ESA

CROP-FOCUSED LOAN PROJECT



ANNEX 9:

SAI PRACTICES FOR GRANT PROJECTS

SAI PRACTICES FOR GRANT PROJECTS

COUNTRIES	CGIAR CENTRE	PROJECT NAME	SAI PRACTICES
Ghana, Senegal, Uganda	Africa Rice	Enhancing institutional breeding capacity to develop climate-resilient crops for African smallholder farmers in Ghana, Senegal and Uganda	Biotechnology use in crop breeding, improved crop varieties, breeding climate-resilient crop varieties
United Republic of Tanzania, Rwanda	Alliance Bioversity International	Climate-smart crop-livestock systems through improved forages and feeding strategies: enhancing productivity and adaptive capacity while mitigating GHG emissions in East Africa	Forage production (including oats), improved dairy cow breeds
Rwanda, Zambia	International Maize and Wheat Improvement Centre	Enhancing smallholder wheat productivity and competitiveness to reduce wheat import ills in Rwanda and Zambia	Bed and furrow planting system, two-wheel tractor powered direct planting, soil fertility management (inorganic fertilizer), improved wheat varieties, disease-tolerant wheat varieties, timely planting
Burundi, Rwanda	International Institute of Tropical Agriculture	Fight cassava brown streak disease and cassava mosaic disease through the deployment and adaptation of new resistant germplasm and clean seed in Burundi and Rwanda	Disease-tolerant cassava varieties, cassava cuttings multiplication, use of tissue culture to clean adapted cassava varieties

SAI PRACTICES FOR GRANT PROJECTS

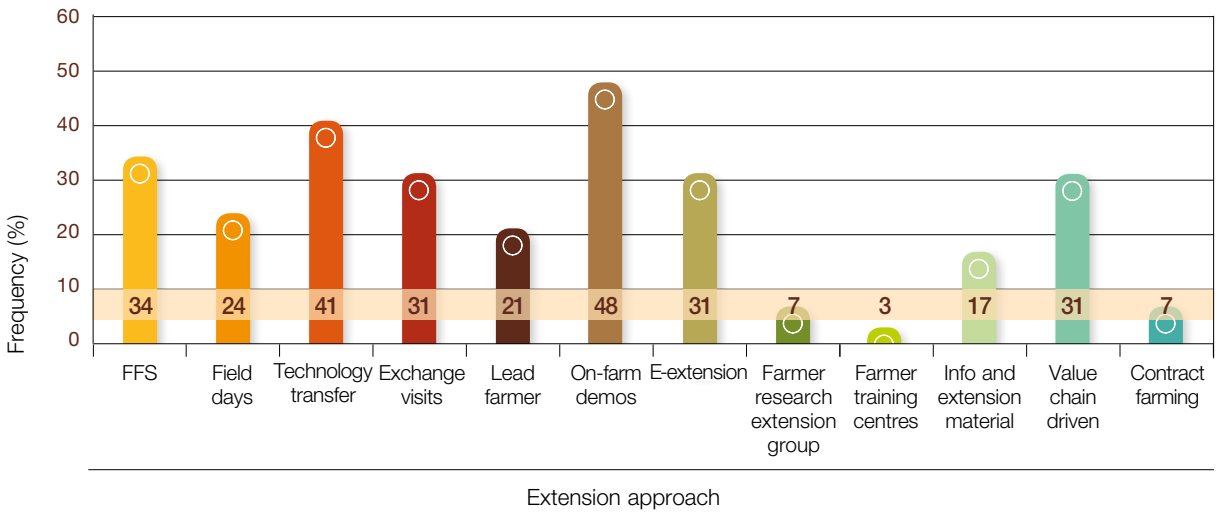
COUNTRIES	CGIAR CENTRE	PROJECT NAME	SAI PRACTICES
Ethiopia, Uganda	International Centre for Research in Agroforestry/Bioversity	Agro-biodiversity and landscape restoration for food security and nutrition in Eastern Africa	Improved crop varieties, tree-crop diversification (fruit trees, pulses, cereals, vegetables, yams)
Kenya, United Republic of Tanzania	International Crops Research Institute for the Semi-Arid Tropics	Strengthening Sorghum and Millet Value Chains for Food, Nutritional and Income Security in Arid and Semi-Arid Lands of Kenya and Tanzania (SOMNI)	Improved crop varieties, intercropping, seed multiplication, open pollinated varieties, pest and disease management, mechanization (threshing)
Ethiopia, South Sudan	International Center for Biosaline Agriculture	Rehabilitation and management of salt-affected soils to improve agricultural productivity in Ethiopia and South Sudan	Irrigation (drip, furrow), agroforestry, seed multiplication, salinity tolerant crops, forage production, land rehabilitation
Kenya, United Republic of Tanzania	International Livestock Research Institute/ Center for International Forestry Research	Greening livestock: incentive-based interventions for reducing the climate impact of livestock production in East Africa	Improved livestock feeding, manure management, artificial insemination, forage production, mechanization (stover choppers)
Cameroon, Ethiopia, Ghana, Madagascar	International Bamboo and Rattan Organisation	Inter-Africa Bamboo Smallholder Farmers Livelihood Development Programme	Agroforestry, fodder production, planting materials multiplication, land rehabilitation
United Republic of Tanzania, Rwanda	World Fish	Improving the technological foundations for sustainable aquaculture	Improved fish feed, use of biotechnology to improve fish breeds

ANNEX 10:

EXTENSION APPROACHES USED FOR DISSEMINATING SAI PRACTICES IN ESA

On-farm demonstration to promote SAI practices was the most popular approach used in the loan projects (figure 5). Capacity-building of extension agents through the transfer of technologies was widely used to equip frontline staff with new skills and knowledge so that they could adequately backstop project beneficiaries. Farmer training centres were used only in the PASIDP II project in Ethiopia, and both farmers and extension service agents improved their knowledge and skills in SAI practices at the centres. The value chain approach, which included participation of the private sector and market actors, also facilitated the uptake of SAI practices. The effectiveness of each extension approach in increasing crop and livestock productivity and transforming smallholder agriculture can be evaluated and documented in future projects.

FIGURE 5. PREVALENCE (%) OF EXTENSION APPROACHES IN THE LOAN PROJECTS IMPLEMENTED IN ESA



International Fund for Agricultural Development
Via Paolo di Dono, 44 - 00142 Rome, Italy
Tel: +39 06 54591 - Fax: +39 06 5043463
Email: ifad@ifad.org
www.ifad.org
www.ruralpovertyportal.org
ifad-un.blogspot.com
www.facebook.com/ifad
instagram.com/ifadnews
www.twitter.com/ifadnews
www.youtube.com/user/ifadTV