Implementation, Performance and Outcomes of Climate-smart Agriculture in the Climate Change Agriculture and Food Security Climate-smart Villages in Uganda

[1]Olaide AKINYEMI, [1]Olanrewaju OLANIYAN, [2]Caroline MWONGERA and [3]Aton EITZINGER

[1]Center for Sustainable Development, University of Ibadan, Nigeria
[2]International Center for Tropical Agriculture (CIAT), Kenya
[3]International Center for Tropical Agriculture (CIAT), Cali,Colombia

Email: laideakin@gmail.com

ABSTRACT

The research work assessed the different climate-smart agriculture practices carried out by smallholder farmers, assessed the performance and implementation rate of the practices, and identified barriers and enablers for wide-scale adoption of the practices in order to scale up climate-smart agriculture among smallholder farmers in Uganda. A multi-stage random sampling method was employed to survey 85 households of 154 smallholder farmer respondents in the study area. Data was analysed using multivariate analysis and tested for significance, while percentiles, graphs and an inductive analytical method were used.

The findings revealed the implementation rate, performance and outcomes of the selected practices for scaling up CSA in Uganda. It also proffered recommendations on how to maintain and further strengthen the practices in Uganda.

Keywords: Climate-smart Agriculture, Uganda

Introduction

The agricultural sector is a key sector of both the global economy and many national economies. It provides livelihood and basic subsistence needs for millions of people, and contributes to the achievement of food security in both developing and developed countries. Worldwide, agricultural production is expected to decrease under climate change projections, posing a threat to global food security (IPCC, 2007). However, it is also important to note that agriculture contributes a significant amount of global emissions annually, which would increase with the intensification or expansion of production to meet higher demand.

There is growing acknowledgement that agriculture and food systems need to change, irrespective of climate change (IFAD/FAO/WFP Biodiversity submission). The last time the world faced such pressure to find a permanent solution to world food insecurity was in the 1960s and 1970s, when food production and distribution could not keep pace with the growing population (primarily in Asia). The response was the Green Revolution: high-yielding, pest/disease resistant varieties of mainly rice and wheat were introduced and their cultivation was supported through subsidies for inputs such as seed, fertilizer and irrigation (FAO data).

Climate-smart agriculture (CSA) puts the challenges of agricultural development at the heart of transformational change in agriculture by concurrently pursuing increased productivity and resilience for food security. Land tenure insecurity for millions of smallholder farmers, including women, declining soil fertility, degraded ecosystems, poor market access, inadequate funding and inadequate infrastructure development continue to hinder agricultural development in Africa. These challenges are expected to be further exacerbated by climate change which has emerged as one of the major threats to agricultural and economic development in Africa.

The need for climate-smart agriculture for the world's 500 million smallholder farmers cannot be overlooked, they provide up to 80 per cent of food in developing countries; manage vast areas of land (farming some 80 per cent of farmland in sub-Saharan Africa and Asia) and make up the largest share of the developing world's undernourished. As the most vulnerable and marginalized people in rural societies – many of them are women heads of households or indigenous people – they are especially exposed to climate change. They inhabit some of the most vulnerable and marginal landscapes, such as hillsides, deserts and flood plains. They often lack secure tenure and resource rights and rely directly on climate-affected natural resources for their livelihoods.

Climate-smart agriculture might have the potential to offer 'triple-win' benefits from increased adaptation, productivity, and mitigation (Lipper et al., 2010), providing a possible strategy to address both climate change and food security concerns. Climate-smart agriculture involves the use of different 'climate-smart' farming techniques to produce crops or livestock, which could help reduce pressure on forests for agricultural use as well as potentially maintain or enhance productivity, build resilience to climate change and mitigate the sector's high emissions (Maybeck and Gitz, 2013).

Climate change is adding pressure to the already stressed ecosystems in which smallholder farming takes place. Over the centuries, smallholders have developed the capacity to adapt to environmental change and climate variability, but the speed and intensity of climate change is outpacing their ability to respond. Many of IFAD's smallholder partners are already reporting climate change impacts on the key ecosystems and biodiversity that sustain agriculture. In the absence of a profound step change in local and global action on emissions, it is increasingly likely that poor rural people will need to contend with an average global war warming of 4° C above pre-industrial levels by 2100, if not sooner (Betts et al., 2011). Such substantial climate change will further increase uncertainty and exacerbate weather-related disasters, droughts, biodiversity losses, and land and water scarcity. The major cereal crops (such as wheat, rice and maize) are already at their heat tolerance threshold and, with an increase in temperature of between 1.5° C and 2° C, could collapse (IPCC, 2010). Livestock productivity will be affected by increased temperature with higher-yielding breeds more likely to be negatively affected than more-robust local breeds. The rise in temperature will, of course, have an impact not only on crops and livestock but also on the pests and diseases they are exposed to. Some farming systems will not remain viable because of climate change, and will require farming system shifts (IPCC, 2010).

Due to constraints, project evaluations are often undertaken after projects have finished, making it too late to make improvements. Even when impact assessment is considered from the beginning, such activities usually do not take into account farmer/participant feedback systematically. This research intends to monitor and explore the implementation level of CSA practices, evaluate the performance of the practices as well as outcomes which will serve as a feedback mechanism for the stakeholders in order to keep track of the project, learn lessons from it and also make adjustments where necessary.

Agriculture is a fundamental instrument for sustainable development and poverty reduction, and agricultural growth can be a powerful means for reducing inequalities. The 2008 World Development Report found that growth originating in the agricultural sector is two to four times as effective as growth originating in non-agricultural sectors in increasing the incomes of the bottom third of income distribution (WDR, 2007). Agricultural growth has been the main instrument of rural poverty reduction in most developing countries in the recent past, and this is not a surprise as agricultural growth has a much more direct impact on hunger than general economic growth (Binswanger-Mkhize et al., 2009). According to a recent study by Timmer and Akkus (2008), no country has been able to sustain rapid transition out of poverty without raising productivity in its agricultural sector. While in the long run, the way to raise rural productivity is to raise urban productivity (unless the non-agricultural economy is growing, there is little long-run hope for agriculture) and out-migration to these growth areas, historical record is very clear on the important role that agriculture itself plays in stimulating growth in the non-agricultural economy in the short and medium run (Barrett et al., 2010).

Climate-smart agriculture is an approach to help guide actions to transform and reorient agricultural systems to effectively and sustainably support development and food security under changing climate. Agriculture is taken to cover crop and livestock production, and fisheries and forest management. CSA is not a new production system – it is a means of identifying which production systems and enabling institutions are best suited to respond to the challenges of climate change for specific locations, to maintain and enhance the capacity of agriculture to support food security in a sustainable way.

Climate-smart agriculture, which is defined by its intended outcomes, rather than specific farming practices, is composed of three main pillars (FAO, 2013). The agricultural technologies and practices that constitute a CSA approach are, in most cases, not new and largely coincide with those of sustainable agriculture and sustainable intensification. However, under a CSA approach, these are evaluated for their capacity to generate increases in productivity, resilience and mitigation for specific locations, given the expected impact of climate change.

Pillars of CSA

1. Sustainably increasing agricultural productivity and incomes
2. Building resilience to climate change
3. Developing opportunities to reduce greenhouse gases (GHG) emissions compared to expected trends

The overall objective is to examine and monitor the nature and patterns of the implementation, performance and outcomes of the practices of climate-smart agriculture in the CCAFS climate-smart villages.

Monitoring Implementation

Monitoring is the regular observation and recording of activities taking place in a project or programme. It is a process of routinely gathering information on all aspects of the project. To monitor is to check on how project activities are progressing. It involves systematic and purposeful observation. Good management practices include regular monitoring on both a short- and long-term basis. An effective monitoring process provides ongoing, systematic information that strengthens project implementation. The monitoring process provides an opportunity to compare implementation efforts with original goals and targets and determine whether sufficient progress is being made toward achieving expected results.

Performance Monitoring

Monitoring performance is a process of evaluating some sets of criteria. An effective monitoring and data management system records the performance of all institutions with implementation responsibilities.

Performance is the extent to which a project reaches its targets and the degree. To assess performance, it is necessary to select, before the implementation of the project, indicators which will permit rating the targeted outputs and outcomes.

Performance monitoring is also a strategic approach to management, which equips leaders, managers and stakeholders at various levels with a set of tools and techniques to regularly plan, continuously monitor, periodically measure and review performance of the project in terms of indicators and targets for efficiency, effectiveness and impact.

Outcomes

Outcome monitoring is the periodic measurement of knowledge, behaviours, or practices that a programme or intervention intends to change. Outcome is the result or effect of an action, the result of an intervention, the consequence of an action and the way a thing turns out to be.

Climate-smart Villages

The CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS) is working with a number of partners, including national governments and research institutions, to test a range of interventions in climate-smart villages (CSVs) across West Africa, East Africa, South Asia, Latin America, and Southeast Asia. CCAFS also collaborates with local farmers, community-based organizations, national meteorological institutions, and private sector stakeholders. After potential sites are selected, a steering group of community representatives and researchers work together to identify appropriate CSA options for that village. The community chooses its preferred options through a process that is as participatory and inclusive as possible, encouraging women and more vulnerable groups to participate. For example, in 2014, in Lushoto, Tanzania, researchers worked with women and men farmers to gather local knowledge and skills and then developed CSA packages of practices appropriate for demonstration and adoption in the community.

Climate-smart villages are sites where researchers, local partners, and farmers collaborate to evaluate and maximize synergies across a portfolio of climate-smart agricultural interventions. Sustainably increasing agricultural productivity is therefore central to the future of global food security and the realization of the Sustainable Development Goals. Now is the time for action, as practices to adapt agriculture to climatic risks take time to root and become effective. Strategies that enhance climate-smart agriculture are the most appropriate starting point for sustainable agriculture.

CSA is a continuous and iterative process that aims to combine food security, agricultural development and climate change objectives. This concept implies that the cycle of planning, implementation, monitoring and evaluation is one of continuous learning, knowledge sharing, and advancement towards solutions. As agricultural production is part of a complex food chain, many types of stakeholders must be involved in this process. In order to further support CSA, it is essential to measure progress and identify successes and problems of CSA interventions (be they pilot initiatives, projects or programmes). Monitoring will check whether activities are meeting the CSA objectives, as well as project milestones and measures of efficiency, and facilitate adjustment of activities taking account of uncertainties. Within the project, accountability and wise use of resources are promoted by monitoring and evaluation. Good monitoring and evaluation help in such a way to improve the design of future CSA interventions and decision making by stakeholders, and constitute a long-term learning process.

The process requires communication to organize and maintain commitment of all relevant stakeholders. This research is therefore a midline survey that involves asking simple questions on knowledge, attitude, skills, interest and practice to get feedback from household farmers in order to complete the project. The approach incorporates a feedback mechanism to build an evidence base that improves decision making, adoption and impact. Lessons learned from this project will provide a basis for concrete recommendations and for identifying further steps which will allow the effective use of science to inform policy, bring stakeholders together and improve efficiency of investments to successfully confront climate change.

Methodology

This study was conducted in Nwoya district of Northern Uganda. Nwoya District is one of the newest districts in Uganda. It was established by an Act of Parliament and began functioning on 01 July 2010. Prior to that date, it was part of Amuru District. The district lies in the Acholi sub region.

It is bordered by Amuru District to the North, Gulu District to the NorthEast, Oyam District to the East, Kiryandongo District, Masindi District and Buliisa District to the South. Nebbi District lies to the West of Nwoya District. Nwoya, the main political, administrative and commercial centre in the district, is located approximately 44 kilometres (27 miles) by road, southwest of the city of Gulu, the largest metropolitan area in the sub-region. This location is approximately 330 kilometres (210 miles) by road, north of the city of Kampala, Uganda's capital and largest metropolitan area. The coordinates of the district are: 02 38N, 32 00E. The district is predominantly rural. The 2002 national census estimated the population of the district at 41,010. The district population is growing at an estimated annual rate of 3.3%. Given those statistics, the projected population of the district in 2016 was approximately 159,500. (Uganda Bureau of Statistics (web).

Table 1: Sample locations and sample sizes

Sub-county	Sample Size (Houeshold farmers)
Alero	37
Anaka	15
Purongo	16
Koch Goma	32
Total	100

The target population for this study was all farm households in Nwoya District. This sampling frame of project participants constituted the population from which a representative sample was drawn for the purpose of this study. The target was 100 household farmers, but 85 household farmers and 154 respondents were used for the analysis. This sample size was distributed across the four sub-counties. A multi–stage sampling method was used to select 100 household farmers.

Stage 1: In Uganda, Northern Uganda was chosen using simple random sampling.

Stage 2: In Northern Uganda, 1 district was chosen (Nwoya district) using simple sampling method.

Stage 3: In the district, 4 sub-counties were chosen

Stage 4: In the sub-counties, 37, 15, 16 and 32 households were chosen from Alero, Anaka, Purongo and Koch Goma sub-counties respectively by using the simple random sampling method.

Results and Discussion

The results of the analysis are presented in this section in line with the three objectives of the study and as indicated in the various methodologies. First, the results of the assessment of the CSAs practices are provided.

Monitoring implementation, performance and outcomes of climate- smart agriculture

Monitoring Implementation of Climate-smart Agriculture

The indicator for monitoring implementation of climate-smart agriculture is number of household framers carrying out the different CSA practices. All farmers who were interviewed had adopted at least one practice within the portfolio of CSA practices. The results from the survey show that 90.48% of farmers were practicing row planting at the time of the survey, 7.14% had practiced row planting in the past while 2.38% had never practiced row planting at all.

Most of farmers (84.52%) were practicing intercropping. Only 8.33% had practiced intercropping in the past while 7.14% had never practiced intercropping. On adoption of improved varieties of seedlings, 38.1% of the farmers were planting improved varieties of seedlings; 8.33% had planted improved varieties in the past while 53.57% of respondent farmers had never planted improved varieties.

The majority of the respondents (86.9%) had never practiced minimum tillage, 5.95% were practicing minimum tillage, while 7.14% had practiced in the past. Similarly 67.86% had never practiced mulching; 20.24% were practicing mulching and 11.9% had practiced in the past.

The results from the survey show that the majority of the farmers are practicing row planting and intercropping more than the other CSA practices. The levels of adoption for minimum tillage and mulching were lower because they were newly-introduced practices to the farmers that required changes in the farming system.

Monitoring Performance of CSA Practices

Indicators for measuring performance include increase in yield, increase in income and control of pests and diseases as a result of the different climate-smart agriculture practices.

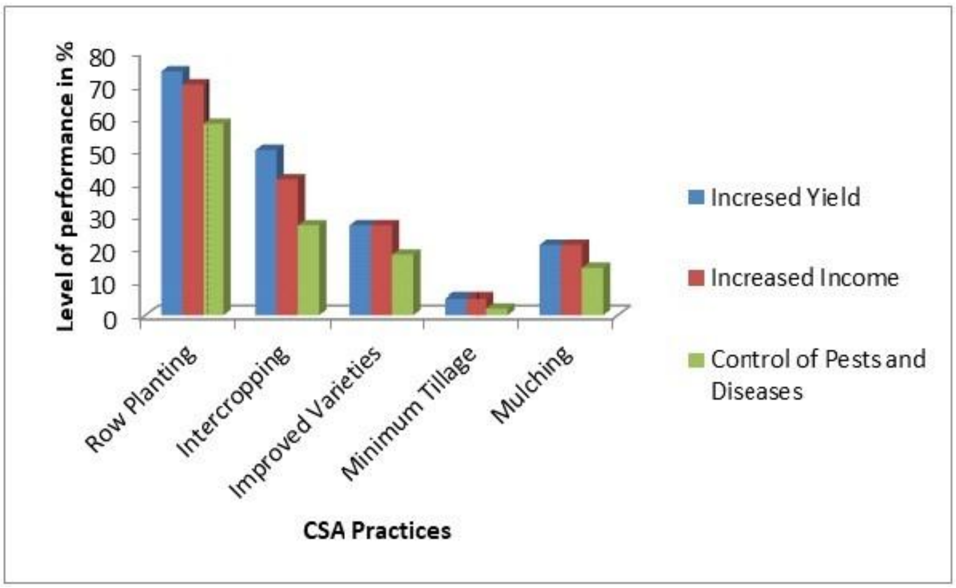

Figure 1: Level of performance of the different CSA practices.

The survey showed that row planting has the highest percentages for performance in terms of yield, income and control of pests and diseases. Under certain conditions, CSA has been found to increase crop yields, enhance carbon content in soils and maintain soil moisture (FAO, 2014). When CSA is used in highland areas, it may further enhance crop production and resilience, even in highly degraded soils due to the interactive effects of improved plant nutrition and soil moisture (FAO, 2014).

Monitoring Outcomes of CSA Practices

The indicator for measuring outcome is the reduced time spent on the field after implementation of the different climate-smart agriculture practices.

The survey results indicate that of all the different CSA practices, row planting (44%) has helped farmers spend less time on the field, followed by intercropping (26.6%), improved varieties (17.4%), mulching (9.2%) and minimum tillage (2.8%). The respondents confirmed that they spent more time on the field when practicing intercropping as against the reduced time spent when practicing row planting. Intercropping involves planting different crops takes more time.

The respondents indicated that improved varieties have been difficult to obtain and when available, the seedlings are not always of the b best quality, which does not give as much yield as expected. The farmers therefore prefer to use their local seedlings. They acknowledged that it is stressful getting mulch and it takes time to gather. Further, when mulch is obtained, it sometimes introduced insects and different pests to the crop being mulched. Minimum tillage did not give the expected yields so the respondents preferred to dig and plant.

Barriers to wide-scale adoption of the CSA practices

Gender Inequality

Gender inequality can hinder adoption of climate-smart strategies. Men, especially heads of households, make the broad management decisions of land allocation, labour organization, cropping/animal rearing patterns and income expenditure. From the study, 87.5% of the women indicated that they have little or no say when it comes to decision making in the family, which in turn affects decisions on what is done on the farm. The women also complained that they are not allowed to take ownership and implement changes at the farm level, and do not have the resources to do so. For instance, women in Africa often have less access than men to resources such as land, inputs, credit, education, and extension services, all of which may be important to support transitions to CSA.

Lack of Capital and Limited Farm Inputs

Non-availability and poor access to high-yielding seeds and breeds are also important barriers to the adoption of CSA. Often, CSA requires special seeds for cover crops or intercrops, which are more difficult to obtain if they are species that have not traditionally been grown locally. From the study, 70% of the respondents reported that lack of capital and limited farm inputs hindered them from adopting the CSA of interest. Unless efficient and reliable input supply chains are established, input barriers will continue to be a hindrance to the adoption of CSA.

Smallholder farmers aiming to adopt CSA practices often are constrained by inadequate cash to invest in land, equipment, labour, seeds, breeds and other farm inputs. CSA is generally more profitable in the long-run compared to conventional farming, but achieving these long-term benefits requires initial investment, which is often prohibitively expensive or risky for small farmers to undertake on their own. Vulnerable farmers are especially risk averse due to household food security concerns, and there is little room for error. In addition, while many farmers reap benefits in the first year of practicing CSA, others do not realize increased yields or profitability for 3-7 years (Hobbs, 2007). During this time, farmers sometimes choose to abandon CSA. Thus, long-term adoption is more likely when CSA provides significant benefits in the first or second year. Such immediate benefit is more likely when CSA is promoted in conjunction with good agronomic practices, improved seeds, and sometimes inorganic fertilizers.

Limited Access to Information

Information is a powerful tool for enhancing adaptation to climate change and variability. From the study, 89.5% of the farmers identified limited availability of information and lack of access to information and knowledge about the short- and long-term benefits of CSA practices as constraints. However, African smallholder farmers either do not have access to appropriate information or are unable to fully utilize existing information. Successful adaptation requires recognition of the necessity to adapt, knowledge about available options, the capacity to assess the options, and the ability to choose and implement the most suitable ones. In terms of climate change, this can be demonstrated through acquisition and dissemination of information on weather hazards. Once such information becomes more available and understood, it is possible to analyse, discuss, and develop feasible adaptation measures. Building adaptive capacity requires a strong unifying vision, scientific understanding of the problems, openness to face challenges, pragmatism in developing solutions, community involvement and commitment at the highest political levels.

Inadequately trained and skilled personnel can limit a community's or a nation's ability to implement adaptation options.

Conclusion

From the study conducted in Nwoya District of Northern Uganda, it was observed that quite a number of household farmers have adopted at least one of the assessed climate-smart agricultural practices. Adoption of these practices has increased yields and incomes, controlled pests and diseases and also reduced time spent on the farm, if implemented properly. It was observed that more male respondents are practicing the CSA practices compared to female respondents. The educational level of most of the household heads was primary education. The respondents had more of dual-headed household type and rear livestock.

This study showed that the majority of the farmers are implementing row planting and intercropping because it is most beneficial to the farmers indicators (crop yield, income, control of pests and diseases and reduced time). Row planting and intercropping were being practiced more compared to the practices of improved varieties, minimum tillage and mulching.

CSA contributes to a cross-cutting range of development goals. It needs to be implemented using an integrated, cross-sectoral approach to agriculture and food security that links it to other aspects of sustainable development, poverty reduction and economic growth. CSA policies and programmes, as with all cross-sectoral development programmes, need to be developed so that they are aligned at all levels of government. This requires an understanding of the structure and functioning of each level of government. Comprehensive capacities need to be developed because in many countries, local-level capacity development has not been included as part of the decentralization processes.

One of the great strengths of the climate-smart village approach is its inclusiveness in bringing together farmers, policy makers, scientists and local organizations to work on a portfolio of practices to adapt agriculture to climate change. Integrating the model into existing or proposed government policies can ensure the food and livelihood security of millions of farmers living in regions vulnerable to climate change.

To create an enabling environment for the development and mainstreaming of CSA in the overarching national plan, appropriate institutions witheffectiveand transparent governance structures are needed. These institutions would coordinate the division of sectoral responsibilities and the work done by national local institutions that will incorporate CSA strategies into legal and regulatory frameworks. Regulations need to be adapted to country environments and accompanied by other supporting incentives if CSA interventions are to be successful in changing behaviour and providing additional incentives for advancing CSA.

Investment in CSA brings long-term gains in productivity, builds resilience, reduces GHG emissions and increases carbon sequestration. The most successful programmes often blend sources of funding. Incentive measures need to focus on overcoming barriers to adoption of CSA practices. Price and non-price measures are needed to support transition to CSA. Behavioural change is also an important element. Price support certainly has a role to play in countries affected by climate change, but often other forms of support (regulations, incentives, capacity development, investments in technology, innovation, efficiency gains and infrastructure, connectivity or the broader enabling environment, social protection and safety nets, and use of social capital) are more effective in paving the way for CSA.

Civil society, the private sector and financial institutions all play vital roles in implementing CSA. These groups should work jointly with key national line ministries and development agencies and donors through an efficient stakeholder consultation process.

Recommendations

1) Creating awareness about climate change and what CSA can do

Many African smallholder farmers and farm communities experience low crop and animal yields but are unaware that this is partly as a result of climate change. Many are not aware of what to do to remedy the situation. The current climate change discourse is very much promoted by international NGOs and some civil society organizations with little contribution from local farmers and communities. An indigenous (African) critical consciousness to climate change is still lacking. It is therefore important that this consciousness is cultivated and raised at all levels in order to change perceptions of climate change so Africa can take responsibility for addressing the challenges it presents. Most of the challenges can be addressed through the adoption of CSA. Whereas resource constraints may limit the practice of CSA, increased consciousness about climate change can enable farmers and farm communities to generate the resources to enable them practice CSA.

2) Facilitating access to finance, credit and farm inputs

Several approaches have been used to overcome the dual financial constraints of the initial investment required for CSA and the potential for negative returns for several years after adoption. These constraints can be overcome by providing low-cost inputs, extending credit to farmers through direct loans or establishment of community financing operations, and educating farmers about the benefits of CSA and ways to improve its profitability. Other rural finance mechanisms can also help farmers overcome the short-term investment hurdle to adopt CSA practices that are more profitable and sustainable in the long run.

3) Mainstreaming gender equality in CSA initiatives

Climate-smart agricultural initiatives are much more likely to achieve their desired outcomes if they encourage women to take ownership and implement changes at the farm level, ensure that women have the resources to do so by reforming institutional arrangements (structure), and work with men to ensure that they value the contributions and ideas of women in regard to this role (relations).

4) Enhancing the capacity of farmers to adopt and use new technologies and innovations

The ability of farmers to apply new technologies and innovations is an important determinant of CSA adoption. Farmers need to be sensitized on existing technologies and innovations to appreciate and adopt them. Sensitization and awareness creation on existing new technologies and innovations are key to promoting adoption and strengthening adaptive capacity. However, new technologies and innovations are costly and sometimes complicated to apply, so farmers must either have the resources, receive subsidies or be provided incentives to adopt them. Availability of markets, especially for value-added products can spur investment in new CSA technologies and innovations and therefore promote adoption.

Slow adaptation to climate change in Africa is partly attributed to low technology adoption. Most agrarian communities are used to traditional technologies that were over generations inculcated into them informally within household and community settings. Any technology not inculcated through early socialization or seen to disrupt the existing livelihood systems will not be accepted and assimilated easily. Therefore, building the capacity of farmers through demonstration, exchange visits and incorporation of socio-cultural aspects is an essential component of any technology transfer package. Technology dissemination should embrace participatory and cross-sector approaches to ensure effective smallholder involvement and sustainability. Overall, enhanced farmer education can speed up technology dissemination and adoption of CSA.

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