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Scaling up climate-smart agriculture

Lessons from ESPA research

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Acronyms

ACES	Abrupt Changes in Ecosystem Services and Wellbeing
AFOLU	Agriculture, forest and other land use
ALTER	Alternative Carbon Investments in Ecosystems for Poverty Alleviation
ASSETS	Attaining Sustainable Services from Ecosystems through Trade-off Scenarios
CSA	Climate-smart agriculture
EBAFOSA	Ecosystem-Based Adaptation for Food Security Assembly
ESPA	Ecosystem Services for Poverty Alleviation
FAO	Food and Agriculture Organization of the United Nations
IPCC	Intergovernmental Panel on Climate Change
NGO	Non-governmental organisation
PES	Payments for Ecosystem Services
PI	Principal investigator
REDD+	Reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries
RRUF	Risks and Responses to Urban Futures
SDGs	Sustainable Development Goals
SSCCM	Smart Subsidies for Catchment Conservation in Malawi
UNFCCC	United Nations Framework Convention on Climate Change

Summary

Climate-smart agriculture (CSA) is an approach for developing agricultural strategies to secure sustainable food security under climate change. CSA has three inter-related objectives, where the first two objectives are emphasised in low-income situations:[1]

1. Food security: sustainably increasing crop yields and productivity and improving farmer incomes;
2. Improving adaptation and building farmers' resilience to climate change; and
3. Improving mitigation (when and where possible): reducing and/or removing greenhouse gas emissions.

ESPA's goal is to ensure that ecosystems are conserved and managed more sustainably, in ways that alleviate poverty and enhance wellbeing. ESPA is concerned that CSA is developed in an equitable way that helps all people to move out of poverty. Comparing ten ESPA projects that focus on agriculture – of which two directly focus on CSA – provides some insight into the opportunities and challenges for scaling up CSA. This synthesis outlines the ESPA evidence from these ten projects, interpreting the findings and implications within the frame of CSA, as well as priorities of the Ecosystem-Based Adaptation for Food Security Assembly (EBAFOSA).[2]

How climate-smart agriculture affects poverty

Evidence gathered across the ESPA projects suggests:

1) Commercially valuable commodities are a key vehicle for the expansion of CSA, with observed differences in CSA adoption across those farmers who did and did not grow or sell those commodities.
2) Climate-smart commodity production is not inherently pro-poor – benefits from such commodities will remain inaccessible to the poorest without careful design and intention.
3) CSA does not necessarily improve all aspects of farmers' wellbeing – trade-offs may exist between growing food crops for domestic consumption and growing cash crops for income, and CSA may not itself lead to improved health, education or basic living standards.

Scaling up climate-smart agriculture – and what it means for poverty alleviation

Scaling up CSA from plot-level to the landscape scale requires the consideration of interactions and trade-offs between agricultural areas and their surroundings. This ESPA synthesis paper highlights a number of considerations and implications for scaling up CSA while alleviating poverty in the long term:

1) The best vehicle for moving CSA forward (commodities) is not the best vehicle for reaching the poorest farmers and building resilience in rural communities. Commodities may garner attention from the private sector and government, but these value chains are rarely in reach of the most vulnerable resilient households. Therefore:
    a) The upfront costs of adopting CSA practices may be too high for farmers. Incentives are often necessary to enable and sustain adoption.
    b) The provision of secure tenure and access arrangements to resources such as land, trees and water is crucial, especially to the most disadvantaged households.

c) Improved agricultural extension services, with access for the poorest, and information on the suitability of CSA practices across different agro-ecological and climatic conditions are critical. Making extension truly pro-poor will require regular and context-specific experimentation to identify the best means of raising capacity in the poorest households.

d) An inclusive CSA strategy requires development of off-farm opportunities in the value chain that can be adopted by marginalised farming community members.

2) CSA upscaling must be embedded in, and managed at, the landscape level to protect remaining natural resources that particularly poor households rely upon for their food, nutrition and resilience.

3) CSA will require support from, and coherence with, policies that address national-level pressures to avoid landscape-scale trade-offs:

a) Metrics for evaluating progress and outcomes towards the objectives of CSA need to transcend the agricultural sector.

b) CSA initiatives must aim to evaluate poverty reduction across multiple dimensions, such as food security, education, health and living standards.

Opportunities for the EBAFOSA network

EBAFOSA as a stakeholder and knowledge platform could play a meaningful role in addressing the following opportunities and challenges, where CSA is proposed to be scaled up:

1. Build a strong and long-lasting partnership involving government, the private sector, donor agencies, non-governmental organisations (NGOs), civil society, and farmers, for a continuous dialogue that builds trust and develops a common vision for CSA;
2. Support this vision with long-term investment in flexible, adaptive management of CSA, developing practices suitable under different economic, social and environmental conditions:

a) Invest in national-level datasets, measurement, monitoring and capacity-building – a lot of experience with CSA techniques and approaches exists, and this evidence needs to be synthesised;

b) Experiment with likely suitable CSA practices to adjust and adapt them to changing conditions over time and locations.

3. Develop context-specific CSA opportunities for the poorest and landless people through incentives, rights or activities further down the value chain or by providing access to wages:

a) Engage with the Sustainable Development Goal (SDG) 1 agenda of leaving no one behind: evaluate who has adopted CSA techniques and has benefited from them;

b) Develop approaches that allow the most vulnerable to access, participate in and benefit from CSA, e.g. by reducing barriers or carefully considering the position of women in households and society.

4. Find policy windows for CSA mainstreaming in each country, where private-sector interests and (inter) national policy interests coalesce:

a) Prepare for the forthcoming spotlight on CSA and other land uses as a result of publication of the Intergovernmental Panel on Climate Change (IPCC) Special Reports on achieving the 1.5°C global temperature target (2018) and on land use (2019).

b) Engage with global climate policy via national and regional representation to the United Nations Framework Convention on Climate Change (UNFCCC) and, in particular, the regular agriculture-focused sessions of the Subsidiary Body for Scientific and Technological Advice of the UNFCCC (SBSTA).

c) Consider the risks and opportunities for CSA funding through UNFCCC-related funds, such as the Green Climate Fund, Adaptation Fund and Least Developed Countries' Fund.

Concerted efforts by stakeholders in local contexts to identify opportunities for the most vulnerable people to access and participate in CSA value chains may be the best approach to making CSA pro-poor in its totality.

Background – what is climate-smart agriculture?

Population growth, changing diets and food demands, biodiversity loss, land degradation, water scarcity and climate change are creating unprecedented pressure on Africa's agricultural production. A large proportion of the population in sub-Saharan Africa still suffer from widespread food insecurity and malnourishment. Individual crop yields are expected to decrease by 10-38% as a result of climate change.[3] Achieving the Sustainable Development Goals (SDGs) by 2030 will require a new development strategy for the agricultural sector to cope with climate change, while contributing to poverty reduction and food security.

The Food and Agricultural Organization of the United Nations (FAO) defines climate-smart agriculture (CSA) as an approach for developing agricultural strategies to secure sustainable food security under climate change.[4] CSA has three inter-related objectives:

1. Food security: sustainably increasing crop yields and productivity, and improving farmer incomes;
2. Improving adaptation and building farmer resilience to climate change; and
3. Improving mitigation (when/where possible): reducing and/or removing greenhouse gas emissions.

The aim of a CSA approach is to create synergies across these three objectives and avoid trade-offs. However, it is recognised that trade-offs sometimes must be made. Identifying who faces these risks is key for scaling up CSA in ways that benefit the most vulnerable people. In low-income settings, a CSA approach would prioritise the first two objectives.

The term CSA covers a wide set of interventions at multiple scales. Micro-level interventions are not limited to on-farm crop techniques, but involve off-farm activities, and fish-, forest- and livestock-based developments. Examples of on-farm CSA activities include soil and water conservation techniques, crop diversification and mixed crop-livestock-fish systems. CSA aims to improve farmer resilience through stabilising yields and reducing exposure to, and impact of, short-term risks to farmers. Climate change may shift the suitable climatic zones for crops such as tea, coffee, maize and cocoa, spread crop and livestock diseases, and lead to more extreme weather events. To cope with climate change effects such as the spread of crop diseases, extreme weather events, and knock-on effects on the distribution of agricultural inputs, CSA solutions aim to reduce vulnerability to crop diseases, and increase the use of techniques such as intercropping and efficient rainwater use and approaches that are based on ecosystems.

Moreover, pre- and post-harvesting techniques, including processing and selling or other activities along the value chain, are included under CSA. At meso and macro levels, a CSA strategy involves the development of supporting activities at community, regional and national scales. These comprise funding opportunities, market access and development, research and development (R&D) of crop varieties and seed banks. A comprehensive CSA strategy includes practices, policies and institutions.

Compared to other integrated landscape approaches, CSA has multiple objectives and a strong focus on climate change and macro-level impact. Agroecology, organic farming and conservation agriculture tend to focus more on ecosystems at a micro level, while forest landscape restoration, Payments for Ecosystem Services (PES), watershed management, natural resource management and sustainable land management all tend to focus on nature-based solutions at a meso level.

As such, conservation agriculture (with its three principles of minimum tillage, permanent soil cover and mulching, and crop rotation/intercropping) is one of many optional CSA interventions that may be suitable in certain conditions. Soil management is one of the recognised CSA techniques supporting the third objective of mitigating climate change. However, it is now well recognised that the suitability of CSA techniques is highly context- and scale-dependent, due to the large differences in agroecology, climate, society, economy and governance across countries and regions. This heterogeneity, combined with the uncertain trajectory of climate change in the future and other factors, implies that there is no single optimal CSA solution. Instead, the development of a CSA strategy involves experimenting with a set of likely suitable CSA activities adjusted and adapted to local conditions.

CSA provides an alternative for traditional intensification, which often ignores environmental (and social) impacts; it explores opportunities to combine organic and inorganic manure and stimulates diversification. Moreover, it advocates intensification rather than expansion into natural habitats where possible. The need to avoid ecosystem degradation is recognised; for example, avoiding deforestation may be a climate-smart landscape approach to mitigate climate change. CSA is also different from sustainable intensification, as it focuses not only on food production, but on all four pillars of food security: availability (the amount of food available), access (physical, social and economic access), utilisation (safe, nutritious and meeting dietary needs) and stability (present at all times).

Policy context

The Africa CSA Alliance is spearheading implementation of the African Union Vision to reach 25 million farm households practising CSA by 2025 (Vision 25x25, African Union-New Partnership for African Development (AU-NEPAD)).[5] This vision came out of the 2014 Malabo Declaration on Accelerated Agricultural Growth and Transformation for Shared Prosperity and Improved Livelihoods.[6] The FAO supports a multi-stakeholder platform called Global Alliance for Climate Smart Agriculture (GACSA),[7] which brings together governments, civil society and private-sector members. Against this wide support, over 300 NGOs have expressed concern about CSA and have voiced their support for community-based agroecology instead.[8] While CSA is sold by its supporters as a win-win for agriculture and poverty, opponents fear that CSA will continue business as usual or prioritise mitigation over food security, and that the demands of large corporations will override the needs of smallholder farmers.[9]

The ambitious goal of the IPCC of achieving the 1.5°C global temperature target will require not only emissions reduction but also actual sequestration of greenhouse gases. In this light, the reduction and avoidance of emissions from agriculture is likely to form a considerable component of the IPCC Special Reports on the feasibility of the 1.5°C target and interventions on land. The IPCC recommendations, the Paris Agreement and Nationally Determined Contributions[10] may provide an opportunity to mainstream CSA into national policy and strategies, such as National Adaptation Programmes of Action (NAPAs) and wider national development and sectoral policies.

These processes may also increase funding for CSA interventions that perform strongly on mitigation and sequestration. However, leading scientific thinking suggests conservation agriculture, biochar, etc., and their role in storing soil carbon have mixed results and these are the topic of many focused reviews (but beyond the scope of the ESPA projects reviewed here). Moreover, it is of concern for poverty alleviation if such funding overrides attention to farmers' livelihoods and resilience. Experience with Reducing Emissions from Deforestation and Forest Degradation (REDD+) and PES funding mechanisms highlights the problems for poor people in securing carbon payments in the absence of secure tenure rights.[1]

The ESPA findings outlined in this report demonstrate a clear caveat: that CSA will not be pro-poor unless careful attention is paid to make it so, both in technical implementation and the financing processes.

Aim of this synthesis paper

The aim of this report is to provide a synthesis of ESPA evidence on CSA of relevance to the Ecosystems-Based Adaptation for Food Security Assembly (EBAFOSA) in Africa. ESPA has partnered with the EBAFOSA country chapters in Malawi and Kenya to synthesise and put into use the evidence arising from ESPA – detailing how, in the face of a changing climate, CSA approaches might contribute to equitable sustainable development in Malawi and Kenya. Through this collaboration, ESPA sought to draw down on EBAFOSA's existing expertise and network while building the capacity of EBAFOSA on this important policy issue.

ESPA's goal is to ensure that ecosystems are conserved and managed more sustainably, in ways that alleviate poverty and enhance wellbeing. ESPA is concerned that CSA is developed in an equitable way that helps all people to move out of poverty.

This synthesis outlines the ESPA evidence base obtained specifically from the ESPA project portfolio, interpreting these findings and implications within the frame of EBAFOSA goals and priorities. This is informed by the following three key questions:

A. Where did techniques lead – or not lead – to enhanced ecosystem services, and how were they chosen or encouraged? (Evidence question)

B. What do these results imply for longer-term pathways out of poverty? (Systems question)

C. What do ESPA project results highlight as good CSA policy goals for EBAFOSA? (Synthesis question)

Method

The FAO's *CSA Sourcebook* [4] provided the framework for our analysis. The first step was to obtain current updates on ESPA project findings vis-à-vis the three questions above via a short questionnaire which was sent to ESPA project Principal Investigators (PIs). This questionnaire (see Annex 1), and some follow-up consultations, pointed to the available literature and outputs from ESPA projects from which evidence was reviewed and synthesised. The PIs of projects listed in Table 1 were then consulted from August to October 2017. Many of these projects obtained co-funding from other sources to complement ESPA funding or continue research. Therefore, some of the outputs and results of the projects are not finalised and/or published.

Wastewater irrigation outside Lahore, Pakistan

Photo credit: Andrew R. Bell

The impact of climate-smart agriculture on poverty alleviation

ESPA projects cover a range of country contexts and differ widely in their methods and foci. Some examine specific commodities or production systems (e.g., cocoa or maize), while others examine landscape types (e.g., wetlands) or agricultural strategies (e.g., sustainable intensification or agroforestry) (Table 1). ESPA projects were designed to examine processes through which ecosystem services could enhance pathways out of poverty and only two ESPA projects focused explicitly on CSA (ECOLIMITS and the Schaafsma Fellowship). However, their comparisons across farm livelihoods that do and do not participate in agricultural programmes, do and do not undertake particular practices, and do and do not access value chains for different commodities provide some insight into the opportunities and challenges for scaling up CSA across these same regions. We extract key messages shared across projects and their implications for larger system-level response to CSA initiatives.

Table 1: Project consultation summary

Project or grant	Summary of results to date and response to CSA synthesis questionnaire
ECOLIMITS (Ghana, Ethiopia) *Cocoa and coffee production*	ECOLIMITS benefited from decades of cocoa and coffee research and policy on REDD+ in Ghana and Ethiopia to implement an integrated study of the relationships between forest ecosystem services and cocoa/coffee smallholder farm management on yields and wellbeing (poverty). ECOLIMITS is developing a physical science basis for what could be climate-smart cocoa/coffee. The research identifies four key ecological factors (fertiliser use, presence of rotting biomass (pollinator habitat), higher soil moisture and proximity to forests) that could be manipulated by farmers or landscape interventions to improve cocoa farmers' incomes. ECOLIMITS sees potential for the lessons from cocoa to apply across other commercial (tree) crops, but suggests limited applicability to staples or other crops without commercial or private-sector interest. It also sees limited participation/access in projects by poorer smallholder farmers, with demonstration plots or lead farmer responsibilities typically falling to well-educated farmers within communities. Policy briefs are available via: www.ecolimits.org/project-impact.html
ASSETS (Malawi, Colombia) *Food security*	Attaining Sustainable Services from Ecosystems through Trade-off Scenarios (ASSETS) collected data on food security and nutrition across two very different parts of the world to understand the importance of ecosystem service flows at forest-farm interfaces in shaping health and livelihoods for rural poor communities. In Malawi, it found a tension in the country's focus on subsidising maize for poverty reduction and the reliance of poor households on rivers, lakes and forests for more food-secure, diversified diets. Finding a means of promoting crop diversity appears similarly important in Colombia as an alternative for relying on inaccessible markets for nutrition.
SSCCM (Malawi) *Conservation agriculture*	Smart Subsidies for Catchment Conservation in Malawi (SSCCM) investigated farmer decision-making regarding conservation agriculture in Malawi via an impact evaluation of an incentive called an agglomeration payment. Early findings are that while incentives are an important nudge to spur adoption, peer effects (i.e. adoption by neighbours) can be just as important. Furthermore, the cost of encouraging conservation agriculture to avoid sediment loading to rivers appear to be much lower than the costs of removing sediment afterwards borne by hydropower providers. This suggests great potential for a PES programme.

Project or grant	Summary of results to date and response to CSA synthesis questionnaire
ALTER (Uganda, Ethiopia) *Wetland and soil conservation*	In Ethiopia, Alternative Carbon Investments in Ecosystems for Poverty Alleviation (ALTER) investigated (a) the use of manure and compost, in combination with chemical fertiliser, for teff and maize production, and (b) the impact of grazing enclosures on local communities. In Uganda, ALTER looked at the challenge of reducing agricultural activity in wetland ecosystems. In both countries, ALTER found that while poor farmers can benefit from management practices to promote ecosystem conservation, wealthier households tend to benefit more. Overall, it found that wetland conservation was unlikely to be a pro-poor practice without the associated development of specific pro-poor instruments. Adding manure in addition to inorganic fertiliser increased yields and incomes, and the results provide support for scaling up this practice in degraded systems.
Schaafsma Fellowship (Malawi) *Diversification and agroforestry*	Schaafsma's work in Malawi examined the adoption potential of CSA strategies such as agricultural diversification and agroforestry. The work found food security interests dominate decision-making. Less food-secure households have limited willingness to pursue non-food tree crops. District-level decision-makers perceived that CSA stands only to benefit farmers with land, but not other members of society. Key findings are that: (a) raising awareness of the benefits of CSA is necessary among both farmers and extension agencies, combined with broader skills training in particular for women; and, (b) a shift in emphasis from food security towards resilience (and thus possibly beyond agriculture) will be necessary if CSA is to be a path to longer-term poverty alleviation.
ACES (Mozambique) *Land-use intensification*	Abrupt Changes in Ecosystem Services and Wellbeing (ACES) compared outcomes from intensification within three different agricultural systems in Mozambique: shifting cultivation, smallholder commercial farming and charcoal production. It observed mixed results across these systems, with wellbeing improving for smallholders and subsistence cultivators under intensification, but decreasing in the longer term for charcoal producers. Overall, the research suggests that while intensification does not seem to undermine poor farmers or drive inequality, it cannot be assumed to lead to pro-poor outcomes on its own.
RRUF (India, Nepal, Bangladesh) *Peri-urban agriculture*	The Risks and Responses to Urban Futures (RRUF) project examined reliance upon peri-urban agroecosystem services for livelihoods across six cities in South Asia. It found that unreliable rainfall provides a push, while strong urban markets for green vegetables provide a pull, for agricultural intensification at the urban fringe. However, the expense of groundwater along with the poor quality of surface water streams mean these practices are highly reliant on available, suitable treated wastewater. The key limiting factor in many cases appears to be uncertainty over access to and use options for land at the fringe, as well as preservation and access to the ecosystem services.
ESPA-Frontiers *Sustainable intensification*	ESPA-Frontiers examined agricultural intensification across 61 cases reported in the literature, spanning Asia, Africa and the Americas. It found the benefits of intensification are mixed, with positive outcomes generally limited to middle-income countries or those with recent rapid economic growth. By contrast, negative outcomes commonly emerge when poorer farmers in any of these contexts have little choice but to intensify, often needing to shift to different crops, reduce fallow or clear land. The project found that a fair measure of intensification generally cannot be made without considering multiple different dimensions.
ESPA-Biofuels (Malawi, Mozambique, Swaziland) *Jatropha and sugarcane*	Unravelling Biofuel Impacts on Ecosystem Services, Human Wellbeing and Poverty Alleviation in Sub-Saharan Africa (ESPA-Biofuels) compared household poverty alleviation and food security outcomes across multiple sites between those participating in sugarcane or jatropha value chains for bioenergy with those who were not. It found these outcomes vary between value chains: those that are involved in sugarcane value chains in Malawi and Swaziland fare better. However, those involved in jatropha value chains as plantation workers (in Mozambique) fare better, while jatropha smallholders (in Malawi) do not significantly improve. The project found sugarcane production undertaken on low-density forest and jatropha hedges at the edges of agricultural plots can lead to carbon storage gains, while the conversion of *miombo* woodland to jatropha plantations creates significant net carbon emissions.

Evidence

Evidence from across the ESPA's relevant projects shows the following key messages:

1. Commercially valuable commodities are a key vehicle for the expansion of CSA.

Most projects gathered information from smallholder farmers in landscapes where key commodities were prevalent: cocoa (Ghana), coffee (Ethiopia), maize (Malawi), charcoal (Mozambique), sugarcane (Malawi, Swaziland), jatropha (Mozambique, Malawi). Except for jatropha in Malawi, all projects observed differences across those who did and did not participate in those commodity value chains. In Ghana, the ECOLIMITS project found private-sector support for zero-deforestation cocoa to have been instrumental in shaping government initiatives and suggested the same could be true for coffee, tea and other cash crops. For Malawi, where government incentives for maize production constitute the largest share of annual government expenditure, efforts at encouraging conservation agriculture by government, international donors and civil society alike focus on maize crops. Sugarcane production is a major economic activity in Swaziland, constituting well above 10-15% of gross domestic product (GDP). As a result, the Government of Swaziland has provided significant support for the expansion of sugarcane production among smallholders, especially the development of irrigation projects. Across these examples, commodities are a focus of government intervention and support, and their modes of production can be shaped by private-sector support.

2. Climate-smart commodity production is not pro-poor.

This second key message from the review sits in tension with the first. Across all of the projects considered, benefits reliably failed to reach the poorest members of agricultural communities. The ECOLIMITS project found that well-educated farmers participated in programmes to encourage better pollination and soil management for cocoa, while the poorer farmers did not. Both the SSCCM project and the Schaafsma Fellowship found that better educated farmers and those with larger land holdings were more likely to participate in incentives for conservation agriculture in Malawi.[11] The ACES project found intensification of agriculture to be a benefit to the poorest households only when markets were local and accessible; the ESPA-Frontiers Sustainable Intensification synthesis project reinforces this finding in its comparison of intensification outcomes across 61 different cases globally in which it found benefits only in middle-income countries or in areas that had experienced recent rapid economic growth. Stepping in the opposite direction from intensification, the ALTER project found that for sustainable land management programmes of wetlands in Uganda, poorer households were less likely to be able to step back from wetlands agriculture as they could only rely on less productive upland areas. The poorest often rely on casual labour for income generation, which drastically restricts their available time for labour on their own plots. Resoundingly across projects, the benefits that spring from intensive, climate-smart production of valuable commodities will not be accessible to the poorest without careful design and intention.

3. CSA does not necessarily improve all dimensions of farmers' wellbeing.

CSA explicitly addresses farmers' food security and income, and their resilience. Poverty and wellbeing are multi-dimensional concepts, and trade-offs may exist between these dimensions. For example, people depending upon farming or fishing may sacrifice food security to be more resilient to climatic variation or continue their farming or fishing livelihood. Schaafsma showed that farmers mainly expect their food security and income (and thereby their access to food, health and education) to improve upon adoption of CSA methods, and to some extent their resilience.[12] However, the expected wellbeing gains depend on the CSA technique adopted, e.g. the number of on-farm trees or the type of crops used for intercropping and crop rotation. Moreover, as the ECOLIMITS project found, poverty dimensions depending on public utilities supplied at community level, such as water, sanitation, education, health and electricity, may not become available even with increases in individual CSA income; multi-dimensional poverty reduction may therefore be limited.[13] The biofuels projects found that those involved in sugarcane and some jatropha value chains tended to have lower levels of multi-dimensional poverty than those not involved. However, when the constituents of the multi-dimensional poverty index are disaggregated, it is found that all groups – paradoxically – show high deprivation for modern energy sources, as biofuels (feedstocks) are shipped outside the production areas.

A final finding from the ALTER and ECOLIMITS projects is that it can be impossible to improve farmers' livelihoods without application of inorganic fertiliser in addition to organic manure. In Ghana, contrary to existing beliefs, the ECOLIMITS evidence shows that adding nitrogen (N) in cocoa systems is necessary; soil depletion limits productivity. It should be noted that adding nitrogen to farming systems can contribute to climate change through emitting nitrous oxide (N_2O), an important greenhouse gas and ozone-depleting substance, when nitrogen is not used efficiently.[14]

Experiments with maize and teff in Ethiopia found that combined application of organic (farmyard, compost) and inorganic (diammonium phosphate (DAP), urea) fertiliser increased maize yields and teff yields. Teff yields were less reduced in the drought year when treated with organic manure. Soil nutrients – nitrogen (N), potassium (K) and phosphorous (P) – improved. These findings are supported by the farm simulation model suggesting that farmer income and nutrition improve when using inorganic fertiliser and compost. Adding inorganic fertiliser and compost improved food security more than adding manure, but it reduced income in comparison to adding only inorganic fertiliser.[15]

Pathways to scale up inclusive climate-smart agriculture

Evidence from the drivers outlined in the ESPA projects suggests pathways for improved landscapes over time via CSA practices. For some farmers, CSA may be an easy choice with obvious benefits to themselves. However, for many, new costs or risks (perceived and actual) that CSA brings can prevent adoption from spreading. Scaling up CSA will therefore require a system of incentives, experimentation and sustained financing, that provides benefits for the most vulnerable people while maintaining ecosystem health.

1. Consider incentives

First, although CSA interventions are not necessarily expensive, upfront CSA costs may be too high for farmers and incentives are often necessary to enable adoption and sustain it. Some of the methods tested in the ESPA project were simple in nature, such as encouraging pollination using dead plantain and banana leaves in cocoa plantations seen in the ECOLIMITS project. However, CSA may require the adoption of new seeds (drought- or heat-resistant) that are more expensive than local varieties, or may only partially reduce farmers' dependence on chemical fertiliser. Some seeds may arise from genetic modification, requiring countries to develop and continuously debate policies on the in-country production of genetically modified crops. Also, farmers may not be able to afford the labour costs of these interventions or may not be able to obtain the natural materials. For example, poor farmers in Uganda lack the capacity to carry out soil management techniques; they spend much of their time working on the land of richer farmers and do not own livestock that would give manure. Moreover, where the benefits of CSA techniques take some time to materialise, such as on-farm trees, then farmers may focus on their short-term needs. There is some discussion in the international literature on CSA on the suitability and type of incentives for smallholder farmers that would increase and sustain CSA adoption,[1] and ESPA research adds insight to this.

Pigeon peas are useful as a food crop, but market prices are too low for many farmers to benefit financially.

Photo credit: Marije Schaafsma

Loans

Producing sugarcane can have significant costs for smallholders associated with fertilisers, agrochemicals, seeds, transport and labour. Although sugarcane smallholders in Malawi and Swaziland are organised in grower associations to access loans for these inputs, the repayment of these loans can take a significant toll on household income. Furthermore, the final received income depends on the sugarcane price set by the buyers post-harvest, which creates significant risks upfront. However, the structure of sugarcane associations can differ across locations, affecting the involvement of the farmers in value chains to a large extent. In Swaziland, sugarcane smallholders are organised in commercial entities that resemble privately-owned plantations. Rather than simply acting as contract farmers (outgrowers), as in Malawi, sugarcane smallholders in Swaziland are equal partners in their associations and receive annual dividends.

Subsidies

Farmers, especially risk-averse individuals, may need subsidies to make these practices affordable and increase adoption.[15] The results of Schaafsma's Fellowship in Malawi suggest that when CSA payments are conditional on the successful management of trees over five years (in an agroforestry system), then farmers consider the risk of losing trees when deciding upon the payment they want to receive.[16] This suggests that setting performance criteria may exclude poorer farmers who are not able to absorb such risks.

The SSCCM project in Malawi focused particularly on conservation agriculture practices: zero tillage, crop residue mulching and intercropping. Short-term risks – waterlogging of crops and drops in yield, for example – discourage experimentation with conservation agriculture, and SSCCM looked at the effect of a subsidy on improving adoption. The evidence suggests that providing subsidies would further increase uptake of intercropping and mulching, but could decrease farmers' preferences for zero-tillage practices; yet the overall impacts of subsidies would be positive, should farmers undertake conservation agriculture over several seasons. The soil-water conservation benefits of conservation agriculture could lead adopters to experience increases to their yields, encouraging sustained adoption. At the same time, reduced soil loss to rivers provides a range of benefits in the landscape (improved aquatic habitat, hydropower provision) and the consumers of these services may be willing to support them explicitly, where financially possible.

Agglomeration payments

Subsequently, the SSCCM project experimented with agglomeration payments, which involve an additional payment to farmers when their neighbours adopt conservation agriculture too. Early findings are that while incentives are an important nudge to spur adoption, peer effects (adoption by neighbours) can be just as important.[17]

2. Provide and protect access and tenure rights

It is not only the provision of financial incentives and materials that counts. Farmers' access to water, their tenure rights (especially land ownership) and rules governing access to and use of resources on the land (such as trees) need to be such that farmers have an incentive to invest in sustainable resource management. This became clear in studying the causes of deforestation in the ECOLIMITS project in Ghana, where land owners do not own the trees on their land if the trees grow spontaneously: only if they can prove they have planted them. In such cases, or when land is not owned by farmers, adoption rates of CSA are much lower. In Ethiopia, the ALTER project found that decisions to invest in soil management technologies depend on secure land tenure rights, together with access to credit. In Malawi, land consolidation was deemed necessary for successful upscaling of CSA.[18]

3. Provide support for off-farm opportunities

An inclusive CSA strategy requires development of off-farm opportunities that can be adopted by marginalised farming community members. In projects such as ECOLIMITS or ACES, where benefits of CSA could include improved commodity production, sustained encouragement of CSA could arise from commodity markets – as described by ECOLIMITS in the development of climate-smart cocoa. However, over the same periods that these encouraging findings can support the scaling up of CSA, the evidence also suggests the potential for landless people and poorer smallholders to be left behind.

While some farmers might see and feel the benefits of CSA without any kind of a nudge, and others may join in as incentives are provided, there are still others who – for lack of land, assets, credit, training or other constraints – may never find it possible to participate. As is the case for countless other agricultural interventions, there is no evidence that CSA will trickle down to include marginalised farming community members. As their peers benefit from support for and benefits from CSA, these farmers may need to increasingly rely on other opportunities outside agriculture. Livelihoods based on off-farm work or farming are most stable and tend to have most assets. However, without support, on-farm labourers are least able to 'step-up' livelihood activities into off-farm work.[19]

4. Build CSA into landscape management

The scaling up of CSA must be embedded in, and managed at, the landscape level, to maintain supporting ecosystem services and complementary resources from catchments, forests and other ecosystems. The interaction between ecosystem services and CSA often takes place at landscape level: between forests and plantations, between rivers and farms. The ECOLIMITS project, for example, found that the cocoa yields tended to be higher in closer proximity to forests. Landscape management is also crucial for the conservation of top soils; soil depletion is a major issue in the region, including in Malawi, Ghana, Uganda and Ethiopia, and reduces household income and food security.

There are considerable trade-offs between local and downstream benefits of conservation of critical natural resources. For example, the area enclosures in Ethiopia for soil and water conservation mainly imply costs to local communities in the form of wildlife crop damages – as the enclosures provide suitable habitat for crop-raiding animals, while the benefits of reduced river siltation are enjoyed downstream.[20] Crop irrigation upstream often reduces the flow quality and quantity downstream, thus limiting fisheries and irrigation opportunities downstream.[21]

Landscape-level management that aims to scale up CSA but conserve critical natural resources may thus require setting limits to agricultural expansion. The pressures on natural habitats of agricultural expansion are especially high when CSA increases agricultural profits and thereby land demands, even more so in a context of population growth. The literature review by Cruz-Garcia et al. shows that expansion of agriculture through forest clearing or wetland drainage results in higher crop production but lower ecosystem and social services.[21] The ALTER work in Uganda on wetland farming shows that potato production in wetlands, while commercially viable and important to poorer farmers, leads to much higher carbon dioxide (CO_2) emissions than, for example, grazing; wetland conservation hence needs to be balanced with community interests. There is a role for climate financing to support climate-smart land management and community-orientated solutions.

5. Take a holistic perspective

Beyond the landscape level, CSA will require support from and coherence with policies that address national-level pressures, such as population growth, fuelwood dependency and limited land and electricity availability. Farmers in focus groups in Uganda, for example, identified population growth as one of the major factors of change in their communities and a prominent cause of poverty; they suggested sensitisation on family planning, supported by increased access to health services, as a suitable strategy for improving their livelihoods.[22]

Energy

Food security requires energy supply, for which most communities in the sub-Saharan Africa region use fuelwood, both urban (charcoal) and rural (firewood). The ACES project showed that without sustainable management, charcoal extraction is traded off against other woodland ecosystem services. Under the large, uncontrolled extraction scenario, forest losses were expected to be highest near roads and towns. In addition, Baumert et al. demonstrate that from the overall revenues of the charcoal value chain, less than 10% goes to local communities, who have low access to markets and little control over woodland resources.[23]

ESPA also provides some evidence regarding the poverty impacts of producing crops for biofuels. Gasparatos et al. reviewed the current evidence about the trade-offs of sugarcane and jatropha production in sub-Saharan Africa.[24, 25] Both crops can be grown in plantation and smallholder settings, having radically different effects. Local benefits can often depend on multiple factors, such as rights and access to water and land, local and national market size, feedstocks and attainable yield. The wider social and environmental context determines the direction and magnitude of these impacts. Sugarcane

A charcoal producer in Malawi
Photo credit: Harriet Smith

can offer much larger benefits to smallholders than jatropha. Jatropha has largely failed in the region and did not deliver the expected benefits as it has low yields, the agronomy was not wellknown and markets were not established.[26] The revenues from selling jatropha were possibly lower than from selling crops.[27] The poverty alleviation and food security outcomes of involvement in bioenergy chains are usually positive for those involved in sugarcane and some jatropha value chains. However, there are several trade-offs related to the diversion of land and labour that need to be fully considered when promoting such crops.[28, 29] For example, while small-scale production, in the form of hedgerows, has little impact on ecosystem services supply in Malawi, it is not profitable and does not seem to have extensive poverty alleviation and food security potential. On the other hand, while larger plantations can be a far more significant driver of land-use change, they can offer modest (but stable) wage income and employment for poorer households, which can provide better access to food and a safety net during droughts.[27, 30]

Implications of scaling up climate-smart agriculture for pathways out of poverty

We observe a key tension for building resilience in rural communities across a number of the projects that studied poverty alleviation pathways arising from improved ecosystem services, focused on different agricultural systems, and collected data across multiple continents. Commodities appear to be a good vehicle for encouraging resilience-building activities such as CSA due to the attention they garner from the private sector and government, leading to an independently sustained agricultural sector. Yet, these value chains are rarely in reach of the least resilient households, due to their lack of land, capital or education, among other barriers. Rather than a win-win for agriculture and poverty, ESPA findings outlined in this report demonstrate that CSA will not be pro-poor unless careful attention is paid to make it so. Many existing CSA interventions have been unable to draw in the most marginalised and leave no-one behind. **Put simply, the best vehicle for moving CSA forward (commodities) is not the best vehicle for reaching the poorest farmers.**

Beyond food production towards resilience and multi-dimensional poverty alleviation

An international ESPA literature review on the evidence of food security and ecosystem services supports this finding, showing that replacing subsistence farming with cash crop production increases incomes but threatens local food security.[21] From a multi-dimensional poverty perspective, this is perhaps unsurprising, showing a challenge not unique to encouraging CSA, but rather a limitation of agriculture in any form to act on its own as a pathway out of poverty.

The ASSETS findings in Malawi suggest that diversification, away from maize and towards a diverse set of crops (e.g. millet, cassava, vegetables) would increase food security (nutrition) and resilience, as these crops are more drought-resilient and would match better with current and anticipated future environmental and climatic conditions. The Schaafsma Fellowship in Malawi notes that a shift in emphasis from food security towards resilience would be necessary for long-term poverty alleviation to be realised, and it is important to consider how household resilience is derived. Food security is one part, but many other ingredients of household resilience have little to do with agriculture – for example access to markets, education, health care, social safety nets – and much more to do with improved connection to urban systems and amenities. Where resilient rural households and communities are the goal, proponents of agricultural development programmes should consider how their interventions can increase the availability and access to options for households outside of agriculture.

A similar warning can be expressed for CSA projects that aim for funding through REDD+ (e.g. through agroforestry) and other climate funding. The objective of such funds is to reduce emissions; poverty reduction becomes a secondary objective for which funds become available after the poor have invested (such as ALTER's example of peatland CO_2 in Uganda). Yet another tension exists between scaling up and increasing productivity, and maintaining a viable natural resource base. If programmes encouraging CSA are to be truly pro-poor, then they must consider how to lessen – or at least not aggravate – the gap that exists between those who benefit from the programme and those at the bottom who are unable to access it. What does this mean in practice?

Extension services and capacity-building

First, improved extension services – with access for the poorest in particular – is a critical part of CSA. Information on CSA includes raising awareness about the suitability of practices across different agroecological and climatic conditions. For example, in Malawi, Ward et al. show that willingness to adopt conservation agriculture is lower among farmers who have experienced crop losses due to flooding and pests (insects),[11] and such risk-related preferences could be acknowledged in conservation agriculture programmes through better information provision. To improve food security, some countries may also need to focus on the importance of diverse diets for food security and health, and invest in campaigns to change food preferences and consumption behaviour, thereby increasing interest among farmers in diversification.

However, extension services themselves face a similar tension in being pro-poor to that described above, i.e. that the most effective vehicle for extension may not be the best vehicle to reach the poor specifically. Faced with scarce resources, extension approaches such as demonstration plots and appointing lead farmers can be effective, but as ECOLIMITS found, those who are best positioned to act as lead farmers or host demonstration plots are not necessarily the poorest households, nor are there mechanisms intrinsic to these approaches that guarantee access to the poorest households. Making extension truly pro-poor will require regular and context-specific experimentation to identify the best means of raising capacity in the poorest households.

In some cases, raising capacity may not be best accomplished through agricultural extension, but through more fundamental investments in goals such as adult functional literacy, with gains for households in their ability to participate in, negotiate with, and benefit from markets. Earmarking resources within any funded CSA initiative specifically for (a) experimenting and identifying local mechanisms to reduce capacity gaps within communities; and (b) raising fundamental capacities such as literacy and inclusive household approaches (acknowledging and embedding gender-sensitive issues in household decision-making), are central to building resilient and inclusive households and communities, a central tenet of CSA.[18]

Women are largely responsible for crop and tree management; projects need to ensure women can manage any additional work.
Photo credit: Marije Schaafsma

Capacity-building is also necessary at meso and macro level, i.e. among strategic and implementing government bodies and development practitioners. This may include the development of a knowledge base around current and future growing areas for crops, such as coffee, cocoa or tea. But it may also involve setting up infrastructure for meteorological information and communication, or the inclusion of indigenous knowledge into strategies and actions.[18]

Metrics

Second, at national scales, metrics for evaluating progress and outcomes towards the objectives of CSA need to transcend the agricultural sector. Observing that gains in wellbeing for poorer households are often made by diversifying their livelihood activities outside agriculture, for CSA initiatives to be truly pro-poor they must incorporate such opportunities in their design. In practice, this means cross-agency, cross-ministerial or cross-sectoral collaborative efforts that can evaluate poverty outcomes across multiple dimensions (and not simply by yield or by completion of project activities), including resilience.[31] Such an approach would also be a suitable response to the challenge of achieving the wide-ranging SDGs.

In this, we are highlighting that CSA is something of a misnomer; agriculture on its own cannot be made 'climate-smart' for all, because household resilience for many households will never be determined solely by agricultural performance in terms of yield improvements. Resilience is fundamentally a wider livelihoods problem. Proponents of CSA should seek to engage the broad-reaching partnerships that are necessary for successful integrated livelihoods programmes. Public-private partnerships in particular, such as PES programmes, may also be important in drawing in private-sector support[32] highlighted earlier as valuable to CSA.

Opportunities for EBAFOSA

This report is intended to support discussions in the EBAFOSA network on CSA, supported by evidence from ESPA. The above synthesis of ESPA knowledge suggests several areas in which EBAFOSA, as a group of influential stakeholders and as a knowledge platform, could play a meaningful role:

1. **Build strong and long-lasting partnerships on CSA that involve governments – from local to national level and from strategic to implementing bodies – the private sector, civil society, NGOs, donor agencies, and community members, including farmers**. This partnership would work on a continuous dialogue of building trust and a common CSA vision. The identification and involvement of powerful stakeholders who are willing to promote CSA and ecosystem services-based approaches could underpin processes to scale up CSA in an inclusive way.
2. **Support this common vision by long-term investment in flexible, adaptive management of CSA, developing practices suitable across different years and economic, social and ecological conditions:**
    a) Long-term investment and engagement will be necessary to understand where particular CSA techniques are suitable, given relevant socio-ecological conditions and future climate projections. Upscaling needs investment in national-level datasets, for example on soils, wetlands, and up-to-date landcover maps, to develop strategic landscape-planning and development for CSA. There is a considerable history with CSA-like techniques, but this evidence has to be collated and made accessible. Further investment would include the measurement and monitoring of carbon emissions and sequestration, as well as capacity-building for these activities;
    b) Yet, experimentation remains a critical part of any upscaled CSA, because pro-poor challenges are hard to estimate and fix in stone – and policy frameworks need to be flexible rather than prescriptive, continuously adopting the latest insights and adapting to recent trends.
3. **Develop context-specific pro-poor opportunities and engage with the 1st SDG processes**. The ESPA experience suggests that income generation further down the value chain may achieve more inclusive, pro-poor CSA development than through on-farm activities. Although not investigated explicitly in ESPA projects, it emerges that opportunities tailored to women and land-poor people such as value addition, processing and packaging, which may also increase in-country benefits from agriculture, seem worthwhile to explore. This will require careful negotiation with private-sector partners. Concerted efforts by stakeholders in local contexts to identify opportunities for the most vulnerable people to access and participate in CSA value chains may be the best approach to making CSA pro-poor in its totality.
4. **Find a policy window for mainstreaming CSA into development in each country**. The cocoa experience in Ghana shows that private-sector interest in sustainable production and (inter)national policy interest in climate change mitigation and poverty alleviation coalesced – leading to policy levers to develop a CSA strategy supported by multiple ministries and non-governmental stakeholders through wide engagement;
    a) In the short term, ESPA recommends EBAFOSA partners to submit scientific contributions and/or contribute reviews to the IPCC Special Report on 1.5°C (2018) and the recommendations on the science of impacts, vulnerability, adaptation and climate mitigation challenges and opportunities in agriculture, forest and other land use (AFOLU) landscapes, as part of the IPCC Special Report on land in 2019;
    b) UNFCCC-related climate funds may promote CSA, but they could also create risks for the agricultural sector, poor farmers and national food security if local and national needs are not carefully considered.[33] Mainstreaming of CSA through inclusion in the AFOLU sector and national climate change acts and strategies (e.g. Nationally Determined Contributions) would be another option.

Annex 1 ESPA synthesis questionnaire

Part 1 – Design

1) Geographic areas:.....

   Spatial scale of the analysis (local/micro, meso/district, macro/national): .....

   Time scale of analysis: .....

2) Please explain the ES to poverty alleviation pathways (observed or theorised) examined in your project.

3) Please describe the methods used in your work (including both natural and social sciences, demonstrating what aspects of the pathway(s) above you analysed, and the timeline of the analysis (e.g., year(s) and rounds of data collection, sequence of methods, etc.).

4) CSA has 3 objectives: improving yields for farmers' incomes, improving farmer resilience and (where possible) mitigating climate change (e.g. through reducing emissions). Which (if any) among these three objectives would you say your project focused on?

Part 2 - Evidence

5) What evidence did your project develop to understand/test understanding of any parts of the pathway outlined in (2)? Please outline any key findings from your evidence or point to key outputs on the subject, if possible. Please also include any expectations on improvements that weren't met, and if possible, an explanation.

6) On the objectives of CSA outlined in (4), did evidence in your project suggest any particular practice(s) as being crucial? If so, please explain.

Part 3 – Implications

7) Following from the evidence you cite above, what would you say are the key implications (at larger scale, over longer time periods) for agricultural management to lead to poverty alleviation outcomes, and the goals of CSA (improved production, household resilience, and greenhouse gas mitigation) in particular? Please point to any outputs on the subject as part of your response.

8) If your study included or examined an intervention, which stakeholders were most likely to benefit (and importantly, who were LEAST likely)? If it was possible/necessary to develop such interventions more equitably, which changes and/or additional policies would be required?

9) Based on your experience, the evidence you obtained in the ESPA project, and your analysis of your system, do you have any recommendations for policy that can help leverage ecosystem services in the encouragement/adoption of the agricultural interventions you studied?

10) As (relatively speaking) experts on the policy context for the countr(ies) where your study took place, we would be grateful for some information on the current status of agricultural management (and if possible CSA) in national policies and their implementation. This information will help us to put your response to (9) in context. Please feel free to comment on goals at different spatial and time scales, as well as feasibility and/or prerequisite support, etc. as applicable.

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