Info Note

Upscaling climate-smart agriculture practices: working with Farmers' Field and Business Schools and Village Savings and Loan Associations in rural Tanzania

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Key findings

- Combining farmer's field and business school and village savings and loan association models increases the adoption of climate-smart agriculture practices among small-scale farmers in Iringa Region, Tanzania
- 66% of farmers, however, chose not to cultivate soybean for the market or for household consumption
- Reasons for low adoption of soybean include lack of access to seeds, climate variability and change, and lack of access to markets

The objective of this Note

This is the first of two Info Notes that summarize research findings on upscaling climate-smart agriculture (CSA) practices among small-scale farmers in rural Tanzania through community-based learning processes and platforms, mainly targeting women farmers. The second Info Note – *Gender considerations in the promotion of climate-smart agriculture practices: Evidence from rural Tanzania* – summarizes findings on the gender dimensions of promoting CSA practices.

This first Note focuses on findings concerning the profitability of CSA practices and the effect of community-based learning processes and platforms on upscaling the adoption of CSA practices. The Note begins with the study background, main concepts, and methodology before presenting and discussing main research results and providing recommendations.

Background

The relationships between agriculture, climate change and human development are many and varied. While providing food, nutrition and income, agriculture can also help address the underlying causes of poverty and social injustice by promoting gender equality, inclusive governance, and resilience to climate change. Agriculture varies dramatically from place to place, influenced by local agroecological and climatic conditions, socio-cultural norms, economic trends, and institutional and policy settings. Climate change has reduced global agricultural production, primarily in the global south, as extreme weather events, higher temperatures, shifting seasons, and erratic rainfall pose significant challenges for farmers. However, agriculture, primarily in the global north, also contributes to climate change through greenhouse gas (GHG) emissions. Globally, it is responsible for roughly one-third of all GHG emissions through land-use changes, the transportation of agricultural products, and unsustainable farming practices.

CSA-SuPER research project

CSA is among several paradigms attempting to address these complex challenges. CSA includes practices, technologies, and institutions to reach three objectives: 1) sustainably increase agricultural productivity and incomes; 2) adapt and build resilience to climate change, and 3) reduce or remove GHG emissions when and where appropriate. Scaling the adoption of CSA practices among small-scale farmers has been challenging for many reasons, including knowledge and innovation skills gaps, lack of access to finance, harmful and discriminatory social norms, poor policy architecture and extension services and other barriers. It is increasingly clear that the failure to

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embed equity and social justice in the CSA paradigm is a major reason for lack of adoption – given that so many women are engaged in agriculture.

CARE, The Alliance of Bioversity International and CIAT, Sokoine University of Agriculture, and Wageningen University and Research conducted research (CSA-SuPER) to examine whether the presence of community learning platforms and collectives that provide agricultural and agri-business knowledge and access to microfinance can fill knowledge gaps and address financial barriers for small-scale farmers – and whether this can drive the uptake of climate-resilient practices. Increasing attention to gender equality can help scale the adoption of sustainable practices - an issue which this project also aimed to explore and address. To do this, the project overlayed CARE's SuPER (Sustainable, Productive, Equitable and Resilient) principles on the CSA objectives. The outcomes sought from SuPER are food and nutrition security and greater resilience to climate change (see Box 1).

Box 1: SuPER Principles

SuPER is a set of principles that guides CARE's work in small-scale agriculture in a changing climate. In broad terms, **sustainable** implies agriculture that is protecting and enhancing the natural resource base and at the same time is driven by inclusive and accountable institutions and policies and by accessible financing. The **productive** principle implies increased yields and incomes for small-scale farmers and meeting the needs of women producers by reducing labour burdens and improving household nutrition. The **equitable** principle implies enabling equal access to opportunities, resources, services and rewards for women farmers as well as men and promoting access to affordable nutritious food for all. Finally, the **resilience** principle implies that communities are able to withstand and recover from climate-related and other shocks by supporting community-based adaptation, connecting institutions and collectives (such as VSLAs) for better governance, and using information and learning (such as through FFBSs) to support farmer-led knowledge transfer, planning and risk management.

Our research was based on a case study of the Kukua ni Kujifunza (KnK) project implemented by CARE in 15 villages in Iringa District Councils in Tanzania. The project introduced the soybean value chain and CSA practices to mainly small-scale woman farmers through Farmers' Field and Business Schools (FFBS) and Village Savings and Loan Associations (VSLA). See Box 2 for more information on these approaches.

Box 2: Farmers' Field and Business Schools (FFBS) and Village Savings and Loan Associations (VSLA)

FFBS is a participatory, women-focused extension model that helps farmers build skills necessary to increase production, access markets and sell at competitive prices, collaborate, and improve decision-making. It also transforms the status and recognition of women. Evidence shows that participation in FFBS builds women's self-confidence and expands their autonomy, reduces gender-based violence, and engenders respect from their families and communities towards them (CARE, 2017a).

A VSLA is a self-managed group of 20-30 individuals, usually women, who meet regularly to provide its members a safe place to save their money, access loans, and obtain emergency insurance (CARE, 2017b). VSLAs are proven to increase social capital, food security and nutrition, access to services and resources, collective activism – and more. For a detailed discussion and research on savings and credits groups and VSLAs, please see Pamuk et al. (2021a).

The KnK project focuses on practices of soybean cultivation, mulching, crop rotation and intercropping, using organic fertilizer (composting) and rhizobium inoculation.[1] To scale the adoption of these practices, FFBS offered four clusters of trainings.

- Agronomy training on CSA practices provided by extension officers through FFBS demonstration plots established in each village.
- Business and enterprise training on collective marketing, saving, lending, and investing.
- Gender training where awareness was raised among women and men on how exclusion disproportionally affects women, and how gender equality in land management, input access, decision-making, unpaid care, and control over income benefit both women and men.
- Nutrition training on food groups and healthy and diverse diets. This training also included cooking demonstrations (e.g. cooking soybean and nutritional benefits of soybean).

The KnK project supported FFBS training with the VSLA approach, where trained farmers were encouraged to participate in existing VSLAs and use savings and loans to invest in CSA practices.

[1] We note that these are practices applied long before 'CSA' under conservation agriculture and are also considered as CSA practices.

Methods

This Note uses insights from four research studies in Iringa Region that CSA-SuPER conducted between 2018 and 2021:

- A climate risk profile (CIAT and CARE Tanzania, 2019) examines climate change effects on agricultural value chains, using secondary data sources, focus group discussions, and in-depth interviews with extension and government officers, farmers, and value chain actors.
- A cost-benefit study (Karanja et al., 2020) collects detailed financial data comprising 106 farmers from 10 KnK project villages in 2019 to conduct a financial cost-benefit analysis for four CSA practices involving crop rotation or intercropping maize with early or late-maturing soybean varieties.
- A quasi-experimental evaluation study (Pamuk et al., 2021b) investigates the effect of the FFBS and VSLA approach on the adoption of CSA practices among small-scale farmers, using baseline (2018) and endline (2021) survey data from 15 KnK project villages and 18 control villages (see Figure 1 for the spatial distribution of project and control villages). The evaluation focuses on the CSA practices introduced by the KnK project.
- A value chain study (Hella et al., 2021) that uses focus groups discussions and key informant interviews conducted in 2021 to investigate the bottlenecks in the soybean value chain to scale.

In this Note, we first use findings from the climate risk profile study to explain the climate and poverty challenges in the Iringa Region and the importance of scaling CSA practices to address those challenges. Second, we discuss whether the CSA practices introduced by the KnK project are profitable. Then the (quasi-experimental) evaluation study provides field evidence on the contribution of the FFBS and VSLA approach – implemented by the KnK project – to the upscaling the CSA practices. Finally, we summarize the role of input and output market linkages for the success of the approach, using insights from the evaluation and value chains studies.

Research results

Addressing poverty and climate change through CSA practices in Iringa

Agriculture, mainly at small-scale, is the primary economic activity. Climate change, however, is posing considerable risk to this sector. The CSA-SuPER climate risk profile study (CIAT and CARE Tanzania, 2019) found that from 1980-2005, the average annual temperature increased by more than 0.5° C. There is also considerable variability in temperature and rainfall patterns, leading to droughts and floods. This variability has reduced the length of growing seasons as well as the yields of crops that require long growing seasons.

KnK project stakeholders indicated that climate change has adverse effects along all agricultural value chains, affecting all actors at all stages (input provision, on-farm production, postharvest handling, and marketing). The projections in the profile show that increases in temperatures and variability in rainfall will continue in the coming years. Therefore, upscaling the adoption of CSA practices in Iringa will be a crucial strategy to protect the livelihoods of small-scale farmers and improve their resilience to climate change, their incomes, and their food security. Ensuring that this upscaling reduces gender inequality will be the ultimate test of its success.

The profitability of CSA practices in Iringa

Focus group discussions (FGDs) with farmers revealed that crop rotation and intercropping of soybean were the most widely adopted practices. The cost-benefit analysis showed that these practices had the potential to generate profits in short to medium terms (Table 1). We estimated that the net present value of soybean-maize production for 15 years ranged from 748 to 4,028 US dollars per household allocating 1 hectare for an average small-scale farming household in Iringa, depending on the practice. The study projected that farmers could be able to pay back their initial investments for those CSA practices in 2-7 years. These results imply that soybean production can be profitable.

Table 1: Estimated profitability of selected CSA practices introduced by KNK project

CSA practices	Net Present Value (US Dollars per household allocating 1 hectare)	Payback period (years)
Crop rotation – Early maturing soybeans	4,028	2
Crop rotation – Late maturing soybeans	4,284	2
Intercropping – Early maturing soybeans	1,667	5
Intercropping – Late maturing soybeans	743	7

Source: Karanja et al. (2019). Notes: The net present value shows the present value of the total income generated from the practices in 15 years per household allocating 1 hectare. The payback period shows the total number of years to adopt the practices to pay back the initial investments.

Contribution of FFBS and VSLA to CSA adoption, household incomes and food security

Training farmers through FFBSs and linking them with VSLAs stimulated the adoption of CSA practices. The quasi-experimental evaluation showed that the adoption rates of CSA practices were similar in control and project villages in the baseline (Table 2) and increased more in project villages than in control villages for all practices except intercropping[2] (row 7 of Table 2). Particularly, rhizobium inoculation use started thanks to the project while it is not used in the control villages. The project also increased the fraction of soybean producing farmers, also doubled the use of mulching and tripled the adoption of crop rotation (Table 2). These results are robust to controlling for household characteristics through econometric methods.

The project's effect on soybean production was stronger for the farming households participating in both FFBSs and receiving loans from VSLAs. The evaluation study analyzed the effect of FFBSs separately for farming households that received a loan from VSLAs in the 2019/2020 season. The analysis showed that, between the seasons of 2017/2018 and 2019/2020, the soybean production rate increased about 1.5 times and the rhizobium inoculation adoption rate increased 2.4 times as much among project farmers who both received a loan from VSLAs and participated in FFBSs when compared to project farmers participating only in FFBS (Figures 2a and 2b). We did not detect a similar effect of receiving credit on the adoption of other practices. This shows that VSLA loans and FFBS training were complementary to each other for soybean production and rhizobium inoculation use. Both inoculation adoption and soybean cultivation require input investment (purchase of inoculants and seeds) by farmers, while other practices examined by the study do not. This may explain the complementary role of the credit from VSLAs for those two practices.

Figure 1a: Average change in the fraction of farmers that produced soybean from baseline to endline.

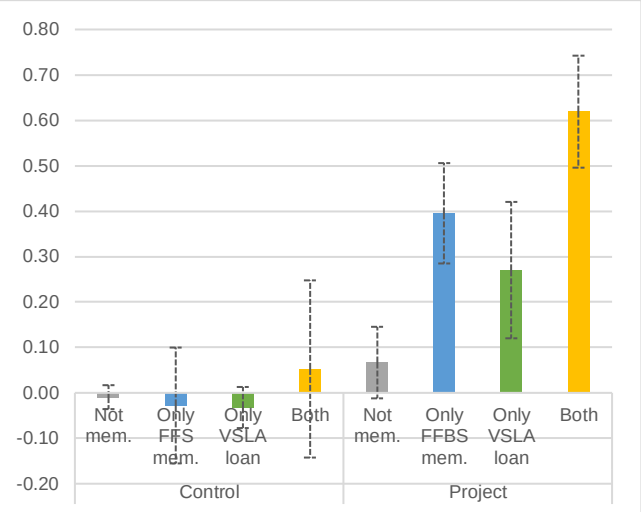
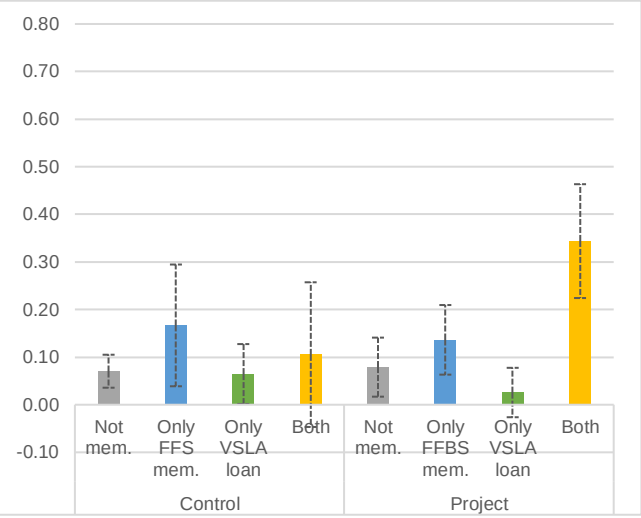


Figure 2b: Average change in the fraction of farmers that used rhizobium inoculation from baseline to endline.



Note: The bars indicate average change in the fraction of farmers that produced soybean or rhizobium inoculation. The dashed lines indicate the 95% confidence intervals, showing the statistical uncertainty in the average changes.

Table 2: Average fraction of farming households adopting CSA practices

			Mulching	Manure composting	Crop rotation	Intercropping	Rhizobium inoculation	Soybean production
Baseline (2017/2018 season)	(1)	Project	0.05	0.53	0.11	0.64	0.00	0.03
	(2)	Control	0.06	0.56	0.15	0.56	0.00	0.03
	(3)	Difference (1)-(2)	-0.01	-0.03	-0.04	0.08	0.00	0.00
Endline (2019/2020 season)	(4)	Project	0.31	0.74	0.37	0.58	0.15	0.36
	(5)	Control	0.2	0.64	0.27	0.56	0.08	0.02
	(6)	Difference (4)-(5)	0.11***	0.10***	0.10***	0.02	0.07***	0.34***
Endline vs. Baseline	(7)	Diff. in diff. [(4)-(5))]-[(1)-(2)]	0.12***	0.13**	0.14***	-0.06	0.07***	0.35***

Source: Pamuk et al. (2021). Notes: The table reports the average fraction of farmer that adopt the practices, in project villages in baseline and endline surveys, which were co selected KnK project farmers and control village farmers. The surveys were conducted in 2018 and 2020 respectively. *** p-value<0.01, ** p-value<0.05, and p-value< 0.1 See further details.

[2] The adoption of intercropping is not economically viable as shown by Ng'ang'a et al. (2020) and the lead farmers from the project villages stated that it is inefficient to implement intercropping in small plots and prefer crop rotation.

The increased soybean production contributed to food security and household incomes. On average, in the 2019/2020 season, a project farmer producing soybean harvested about 64 kg of soybean using 0.13 hectares of land, which is only about 10% of the average land size in our sample of project farmers. Thirty-two % of project farmers consumed soybeans, and on average, these farmers consumed 22 kg of soybeans. Only 12% of project farmers (equivalent to one-third of the soybean producers) sold their products (on average 6 kg of soybeans), implying that about two-thirds of farmers could not market their produce or chose to only use it for home consumption. Increased soybean consumption was an important contribution to the food security of farmers. In Iringa, farmers consume bean-sourced protein more frequently than animal-sourced protein, as they cannot afford to purchase meat, chicken, or dairy products frequently. Soybean has a higher protein content than other beans, providing a cheaper, protein-rich legume alternative to animal-based protein.

The evaluation also showed that the project empowered women by engaging them in socioeconomic groups, particularly in VSLAs. This VSLA engagement is associated with increased soybean production and consumption within farmers' households. We discuss our findings on gender dynamics in detail in our second Note entitled *Gender considerations in the promotion of climate-smart agriculture practices: Evidence from rural Tanzania*.

The bottlenecks to upscaling adoption of CSA practices

Our evaluation study showed that about 64% of project farmers did not produce soybean and soybean producing farmers used only one-tenth of their land for soybean. Why did so few farmers use only small plots for the production, given that soybean was profitable to sell and healthy to eat? We looked for answers to this question first in the data used in the evaluation study and then in the value chain study. The evaluation study identified the high perceived cost of production, unsuitable weather[3] or field conditions, and lack of access to seeds due to limited supply as the major reasons for not cultivating soybean. 74% of farmers who did not produce soybean in the 2019/2020 season reported one of those reasons.

Regarding weather conditions as a reason for non-adoption, one solution the KnK project has employed is annual Participatory Scenario Planning (PSP). Through PSP, farmers are provided with reliable weather forecasts and their capacity to interpret climate information is strengthened. This way, farmers are in a better position to make agricultural decisions, for example, on cultivating (new) crops like soybean, under increasingly uncertain climatic conditions.

The value chain study showed that lack of access to soybean markets was the major bottleneck to upscale soybean adoption in the study region. Many farmers considered soybean as a cash crop and did not consider it an important food item in their diets.[4] Therefore they did not allocate resources to produce soybean unless there was a market to sell the produce at a profit. The value chain study indicated that large-scale soybean processors in the region use imported rather than locally produced soybean, and farmers in the study region did not have contacts with those processors. The study also found that farmers did not have the organizational capacity and skills to establish contracts with large processors and did not know how to produce marketable soya products like soya meat, milk, and oil.

A mismatch between supply and demand in quantities of soybean inputs and outputs was a reason for the lack of access to seeds and output markets by farmers, according to CARE Tanzania KnK staff (CARE and WUR, 2022). Staff explained that, as soybean was a new crop in Iringa, farmers wanted to try it out on small plots and required only small amounts of inputs from dealers. However, all required inputs (e.g. seeds) were not available at local agro-dealers, and bigger input suppliers, where all inputs were available, would only sell those in bulk. Moreover, soybean buyers would only purchase large volumes of soybean.

In 2021, after our studies, access to soybean markets improved.[5] Information from project staff suggests that village market committees met with soybean buyers, negotiated prices and helped farmers to sell their soybean. The numbers shared by staff show that in June 2021, farmers sold about 10 tonnes of soybean in total through the village committees.

Conclusions and policy recommendations

This CSA-SuPER study shows that FFBSs and VSLAs increase the adoption rates of a range of CSA practices, including soybean production, among small-scale farmers in the Iringa Region in Tanzania. Compared to other farmers, VSLA members, in particular are more likely to produce soybean, especially if they accessed credit through their VSLA group. Those farmers are likely to have greater access to finance to invest in inputs needed for the

[3] Our informal conversations with farmers show that the rains were early in the 2019-2020 cropping season. This may have influenced their decisions. The timing of the rains is important, because as farmers have two soybean varieties available (early and late maturing) The decision to thus depends on the timing of the rains.

[4] The baseline survey of the evaluation study also shows that almost no households consumed soybean at home.

[5] This information was shared by KnK project staff.

adoption of soybean and other practices. As many farmers – and particularly women - in the region face significant barriers to access finance, project farmers had been specifically encouraged to invest VSLA savings and credit in new farming practices and businesses.

The increased soybean cultivation (one of the CSA practices introduced by the KnK project) can contribute to household food security and income. The study showed that in soybean-producing households, the consumption of soybean also increased, providing families with an affordable source of protein-rich food. However, despite the potential of soybean for household consumption as well as business, many farmers decided not to cultivate it, and those who did only allocated relatively small plots of land to the crop. Farmers mentioned the limited availability of and access to seeds and unfavourable weather conditions as the main reasons.

Moreover, the large majority of these soybean producers did not market their produce. The first key bottleneck here is the mismatch between the low quantity supplied by farmers and the large quantity demanded by buyers. The second is farmers' lack of knowledge on existing soybean markets and on the demand for soy-based products.

Recommendations:

- Promote the formation of VSLAs and FFBSs in careful sequence so that farmer decision making capacities and resilience to climate change are strengthened. FFBSs increase farmers' access to knowledge and skills on CSA practices. VSLAs improve access to affordable finance, which enables farmers to invest in those practices. This is particularly important for women, youth and other groups who typically face major barriers in accessing formal financial services and agricultural information.
- Explore the options for linking VSLAs with formal banks and investigate whether this linkage to formal finance can accelerate farmers' capital investments by (1) enabling VSLA members to build a track-record with a bank, prove their creditworthiness and access larger formal loans, and (2) expanding the short-term loan capacity of VSLAs through banks providing credit with longer maturity to VSLA groups, which farmers can use for long-term capital investments.
- Incorporate marketing skills and information more effectively in FFBS trainings and other forms of agricultural extension, particularly for newly introduced crops (such as soybean in the case of Iringa).
- Promote the availability of reliable climate information and enhance farmers' capacity to make informed decisions through regular participatory scenario planning.
- Actively form and promote market linkages between small-scale farmers, agro-dealers and potential buyers, preferably through producer collectives.
- Support organized market committees at village level that can aggregate the produce of individual farmers, and collectively negotiate with buyers on volumes and prices.
- Promote the availability, accessibility, and affordability of inputs for CSA practices, particularly seeds, in small-scale farming communities and promote the use of composting.
- Invest in market infrastructure (up-to-date information, storage, affordable and timely transportation, financial services) to enable small-scale farmers to sell their produce and make informed decisions about farming investments.
- Conduct marketing and input-related interventions simultaneously with the farmer training and financial interventions. Existence of markets and inputs will motivate farmers to adopt the CSA practices. Those interventions may include: conducting input and output market research to identify input suppliers and output buyers, and working with para-professional farmers who aggregate individual farmers' input demand at village level and negotiate on farmers' behalf with input suppliers on price, volumes and timing of delivery.

  Ensure active engagement of women and men in crop identification, considering market and income, nutrition, ecological and social dynamics. In particular, ensure analysis and consultation with farmers addresses the gender-related implications of crop choices.

Further reading

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