Chapter 26

Rural Finance to Support Climate Change Adaptation: Experiences, Lessons and Policy Perspectives

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26.1 Introduction

Agricultural development is strongly influenced by the availability of rural finance. Given the time lag between sowing and harvesting, upfront funding is generally required to enable input purchase before returns are realized. This time lag is even larger for perennial (tree) crops and for production practices that have a longer gestation period, such as irrigation, land consolidation and cover crops.

Access to credit is even more important in the adoption and subsequent upscaling of climate-smart agriculture (CSA) practices. CSA investments tend to be resource-intensive and can be recovered only over a long period of time. Farmers who make these investments often are motivated not only by direct costs and returns but also by the prospect of reduced volatility, increased resilience and a higher degree of certainty regarding future revenue streams.

Different types of financial services fulfil different functions in the production cycle. Whereas credit provision is most helpful for short-term input intensification and medium-term investments, market contracts and insurance (e.g., crop, health and life) provide coping strategies for risk-averse decision-makers. Furthermore, savings provide a way for farmers to both pay for inputs and ride out adversity. The effectiveness of these financial services depends on the availability of other non-financial services (such as training, extension and certification) and the incentives provided by the market (e.g., price premiums, input costs and payments for environmental services). The latter types of incentives may enhance the profitability of CSA investments and encourage farmers to adopt CSA practices (Long et al. 2016; Nyasimi et al. 2014).

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There are also crucial differences among the types of agencies that promote climate-smart investments. While on-farm and value-chain investments are driven by private financial returns, public and civic agencies seek to support societal benefits such as sustainability, poverty reduction and inclusiveness. Public-private partnerships can therefore be helpful.

The purpose of this paper is to understand how rural finance instruments (credit, savings and insurance) can support the adoption and upscaling of CSA. We do not address targeted international financial mechanisms (such as Global Environment Facility and Green Climate Fund) that intend to create specific supportive investment conditions for climate-smart practices. Instead, we focus on methods of linking local financial markets with adaptive CSA practices, with the goal of identifying viable market-based pathways for bringing CSA systems to scale. Our study primarily addresses ways to enhance local adaptive capacity, since mitigation usually requires more global and long-term mechanisms.

In this paper, we first outline the theories of change underlying investments in CSA practices. Then we review the available empirical evidence from studies that analyse these pathways. We give special attention to integrated finance models that address critical complementarities among these pathways, and to different analytical approaches for assessing the impact of CSA-supportive financial policies.

26.2 Theories of Change

The term climate-smart agriculture describes systems designed to improve food security and rural livelihoods and to support climate-change adaptation and mitigation efforts. Mitigation refers to reducing greenhouse gas concentrations in the atmosphere, while adaptation—our focus in this paper—aims to reduce vulnerability to anticipated negative impacts of climate change such as rising temperatures, increases or decreases in precipitation, and changes in the timing of the rain season (UNFCCC 1992).

Meeting the financing requirements for implementing CSA is a significant challenge, since both technological innovations and socio-economic and institutional changes are required. There are three markedly different pathways for assessing CSA investments (Fig. 26.1):

- Direct pathway: Financial instruments for enhancing direct investments for climate-smart practices, ranging from short-term input loans to medium- and long-term loans (Pender and Gebremedhin 2008; Arimi 2014; Marennya et al. 2014; Nyong et al. 2007);
- Indirect pathway: Economic incentives for supporting farm-household incomes that generate expenditure effects in favour of climate-smart practices (Lopez-Ridaura et al. 2018; Ksoll et al. 2016; Jette-Nantel 2013; Wood 2011);

Fig. 26.1 Impact pathways for financing CSA practices. (Source: elaborated by the authors)

- Behavioural pathway: Incentive mechanisms that influence behaviour towards weather risks and enhance resilience of revenue streams generated by climate-smart practices (Dercon and Christiaensen 2011; Brick and Visser 2015).

In Fig. 26.1 we outline these three pathways but also indicate that there might be critical interactions among them. Improved input use and CSA investments (pathway 1) are likely to result in higher net incomes (pathway 2), thus reinforcing the opportunity for a (self-financed) investment pathway (Pender and Gebremedhin 2008). In a similar vein, if farmers become more tolerant of risk (pathway 3) they will be more inclined to intensify input use (pathway 1) (Arslan et al. 2016). And farmers with higher income (pathway 2) tend to become less risk-averse (pathway 3).

Disentangling these pathways is difficult but important. Most research on CSA investments has focused on the identification of supply-side financial services (Branca et al. 2012) that can best cover the costs of adaptation (see www.cgiar.org/blog/series/climate-smart-financial-services). And it is true that in less-developed markets, lack of available financial services can be the major limiting factor. Far more often, however, the constraint is on the demand side: low-income smallholders often simply do not wish to borrow money to make CSA investments. Physical access to rural banking facilities is still very limited, resulting in high transaction costs for loans (Branca et al. 2012). Farmers also resist borrowing based on aversion to risk and transaction costs. Opportunity costs (of time and assets) can be barriers as well (McCarthy et al. 2011).

Effective financing of CSA requires business models with multiple market linkages—on both the input and output sides—and integrated contracts that simultaneously enable input intensification and enforce rewarding output market engagement (Hayami and Otsuka 1993; Ton et al. 2017). Creating complementarities, coherence and synergies between instruments and practices represents a major challenge for reaching CSA policy effectiveness. Therefore, interactions between the three CSA finance pathways are of critical importance.

26.3 Evidence Base

Few studies address the wide variety of barriers (financial, economic and behavioural) that stand in the way of CSA investments. The effectiveness of finance for CSA adoption can be judged by considering the net welfare effects at farm-household level (income, health and food) and the environmental effects at village/landscape level. This includes the simultaneous improvement of income/wealth and sustainability by reducing trade-offs and managing volatility. Many available impact studies (Norman et al. 2015) focus, however, on higher scale levels (village, region, district) and on single indicators (either socio-economic or sustainability outcomes).

Suitable finance depends on the type of CSA practices undertaken (see Table 26.1). Some require upfront investments in inputs (e.g., adapted seed varieties or integrated nutrient management), whereas others require longer-term investments (e.g., laser levelling, solar pumps, land-water conservation). Credit amounts involved and their impact on household risk and cash flow can differ widely, with consequences for the required financial products. Sometimes a CSA practice can be easily accommodated in the household production system, without the need for external finance (Asfaw et al. 2014; Di Falco et al. 2012; Yirga and Hassan 2006).

The impacts of different CSA practices can vary widely as well. Whereas CSA practices targeting improved water and nutrient management and diversified seed systems focus on input efficiency (pathway 1), weather-smart services may be particularly helpful in reducing risks (pathway 3), and market reforms deliver more potential for managing the vulnerability and composition of revenue streams (pathway 2). This also translates into different credit scores used by financial institutions, which tend to vary depending on the likelihood of reaching improved efficiency and/or higher resilience (Basak 2017).

We will briefly discuss some key finding from these field studies that address the three impact pathways. This also permits us to highlight major differences in the approaches to assessing impact.

26.3.1 *Input Intensification and Investment Pathways*

Many adoption studies point to rural finance as a key enabler of technology change (Feder et al. 1985; Feder and Umalı 1993). The positive impact of credit use on CSA adoption has been confirmed in studies of highland crops in Ethiopia (Pender and Gebremedhin 2008), fisheries systems in Nigeria (Arimi 2014) and soil conservation in Malawi (Marenja et al. 2014).

To assess impact, these studies generally rely on cross-section regression for likelihood of adoption with a single binary dummy for access to credit services. Few studies rely on balanced samples or use sound counterfactual procedures for robust impact analysis. In fact, individual characteristics are highly correlated with access to credit, and therefore sample selection correction methods (Heckman procedure)

Table 26.1 Examples of evidence of the effect of financial services on the adoption of CSA practices for adaptation

CSA practice	CSA type ^a	Case	Evidence
Pathway 1: Input intensification and investment			
Land management practices: manure or compost, burning to clear the plot, contour ploughing, reduced tillage, intercropping or mixed cropping	Carbon-nutrient smart	Pender and Gebremedhin (2008) on smallholders in Ethiopia	Credit is not strongly associated with the use of land management practices
Adapting aquaculture practices (e.g., water management in ponds, shifting production calendar)	Water-smart	Arimi (2014) on fish farmers in Nigeria	Fish farmers with access to credit showed higher adoption rates of adaptation measures
Conservation practices that reduce soil erosion and increase yields	Carbon-nutrient smart	Marennya et al. (2014) on small farmers in Malawi	Most farmers preferred cash payments to index insurance contracts, even when the insurance contracts offered substantially higher expected returns. Further, more risk-averse farmers were more likely to prefer cash payments
Pathway 2: Income and expenditures			
Changing crop varieties, soil and water conservation measures, water harvesting, tree planting, change planting and harvesting dates	Seed-breed smart, carbon-nutrient smart, water-smart	Di Falco et al. (2012), cereal farmers in Ethiopia	Access to formal credit had a positive but not significant effect on the adoption of the practices
Planting of agro-forestry trees, change of date of planting, land terracing, construction of drainages, cover cropping, making ridges across slope, selling assets, borrowing loans, diversifying livelihoods, short-term migration, support from social network, compensation of losses from government	Weather-smart, water-smart, carbon-nutrient smart, institutional-market-smart	Enete et al. (2016) on flood-coping strategies of small farmers in Nigeria	Access to credit had a negative relationship with selling of assets and short-term migration, suggesting that farmers do not need to recur to more radical and expensive coping strategies when they have access to credit

(continued)

Table 26.1 (continued)

CSA practice	CSA type ^a	Case	Evidence
Maize-legume intercropping, soil and water conservation measures, organic fertilizer, inorganic fertilizer, high-yielding maize varieties	Carbon-nutrient-smart, seed-breed-smart	Arslan et al. (2016) on maize farmers in Tanzania	Positive effect of credit for practices that require liquidity (inorganic fertilizer, improved seeds). Negative effect of credit for intercropping, probably because intercropping is perceived as a way to compensate for lack of fertilizers. Credit appears to increase the use of modern inputs but decrease maize-legume intercropping, a practice that has which has longer-term benefits for soil health and adaptation
Pathway 3: Risk mitigation			
Diversity of climate change adaptation practices	Weather-smart, water-smart, seed/breed-smart, carbon-nutrient-smart, institutional/market-smart	Shackleton et al. (2015) reviewing evidence from 64 case studies worldwide	The cluster “financial, technical and infrastructural barriers” is the most cited barrier. This includes lack of cash and lack of credit, but also lack of inputs and poverty in general
Forest sequestration (mitigation), CSA (adaptation) and information-communication (disaster management)	All	Wong (2016) reviewing evidence from a variety of case studies worldwide	Women face more obstacles in accessing credit and cash, preventing them from adopting certain practices. Existing policies have not paid sufficient attention to the gender gap in access to land, capital and other productive resources. Engaging women in CSA without fully understanding the constraints they face risks reinforcing their subordinated positions
Crop diversification, adjustment of crop management practices or agricultural calendar, land use and land management, and other strategies	Weather-smart, carbon-nutrient-smart, institutional/market-smart	Yegbemey et al. (2014) on maize farmers in Benin	Access to credit enables the farmer to choose adaptation strategies that require investments (larger doses of fertiliser, purchase of better seeds, etc.)

^aWe use the CSA typology from CCAFS (2016)

should be used for unbiased impact assessment (Lipper et al. 2018). It must also be noted that little distinction is made between different types of loans (formal vs. informal) and their terms and conditions (such as loan size, interest rate, collateral requirements and duration). Loans can serve rather different purposes (e.g., a micro-credit loan for a woman's trading activity plays an entirely different role in the household economy than a crop input loan) and will thus have different effects on resource-management practices and CSA outcomes.

The overall evidence base supporting the idea that lack of available credit limits CSA adoption is therefore rather weak. Sometimes access to credit can even lead to land-use specialization and intensification at the expense of climate-friendly technologies. For resource-poor farmers, credit constraints can support the adoption of more labour-intensive climate mitigation practices as an alternative to more expensive external input technologies (Rioux et al. 2016). As Arslan et al. (2016) demonstrated for Tanzania, improving access to credit is likely not only to increase the adoption of modern inputs (such as high-yielding maize varieties and inorganic fertilizer) but also to decrease maize-legume intercropping practices that have longer-run benefits for soil health and adaptation. There are thus important trade-offs to be considered among different intensification strategies that are supported through access to finance.

26.3.2 *Income and Expenditures Pathway*

For investing in CSA, access to savings and financial services such as insurance, transfers and remittances may be as important as access to credit. Poor farmers who wish to avoid debt may prefer to invest using funding from their own non-farm or off-farm income. An indirect pathway may work best: helping farmers to build a larger household income derived from a variety of resources may allow them to make investments in CSA practices.

Based on integrated farm-household models that combine production and expenditure decisions (Singh et al. 1986), smallholder farmers who have solid expectations for stable revenue streams (even at low levels) are more likely to invest in CSA practices (Lopez-Ridaura et al. 2018; Ruben et al. 2007). Such models also enable assessment of the likely impact of different policy incentives on the allocation of resources within the farm household. Analytical simulation modelling suggests that risk-sharing instruments (e.g., risk-bearing credit, input dealers' risk sharing, voluntary cost sharing and hired-labour risk sharing)¹ can lead to higher CSA adoption rates compared to subsidized loans. In fact, offering low-interest credit appears to be a relatively ineffective strategy for encouraging the adoption of agricultural technologies (Feder and Umali 1993). Instead, activity diversification has repeatedly been shown to encourage both savings and investing in strategies that help cope

¹ Much of the risk modelling takes place within the framework of the AgMip programme (<https://www.agmip.org/>).

with risk (Ksoll et al. 2016). Moreover, rural households are more likely to make in-depth CSA investments if they either receive remittances or are engaged in off-farm employment, since these give access to more stable revenue streams (Jette-Nantel 2013).²

26.3.3 Risk Mitigation Pathway

Investment in CSA is closely related to perceptions of risk. Dercon and Christiaensen (2011) show with panel data from Ethiopia that households have different tolerances for taking on risky production technologies based on their fears of poor harvests. In this situation, CSA adoption is discouraged not just by lack of credit but also by a lack of insurance or other risk-mitigating measures. Either indemnity-based or index-based insurance might help (Ndagijimana et al. 2017; Brick and Visser 2015).

CSA practices may also require that farmers have access to specific inputs, such as tree seedlings, seeds or fertilizers. Many farmers lack access to fertilizer, which is a key determinant of productivity and efficient resource use. Duflo et al. (2011) have shown with experiments in Kenya that innovative means of input delivery—including those that rely on mobile phones—can improve the certainty of input available and thus enhance CSA use.

Intra-household decision-making can also play an important role in risk mitigation and resource allocation. Women tend to be somewhat more risk-averse but are also more likely to invest in activities with a longer gestation period (Wong 2016). Consequently, gender-transformative rural finance strategies are likely to be better able to overcome trade-offs between short-term (consumption) and longer-term (resource conservation investment) goals (World Bank et al. 2015).

26.4 Complementarities

Our discussion of these different pathways may give the impression that we are dealing with fully separate activities. That, of course, is not the reality of rural finance, where financial products and services tend to be linked to several farm household activities. The connected nature of financial services and activities can offer advantages. Since rural households simultaneously target a number of different objectives (like nutrition, resilience and resource-use sustainability), it is important to build synergies between instruments that contribute to climate-change mitigation, adaptation and food security.

²There is also some contrary evidence in the sense that remittances are not used to invest but rather to increase consumption or reduce labour supply (Lartey 2013).

Fig. 26.2 Rural finance CSA outcomes and impact analysis framework. (Source: elaborated by the authors)

Understanding the different aspects of rural finance—credit, savings and insurance—allows a better understanding of its contribution to CSA upscaling. While each instrument may be useful in its own right, a combination offers the greatest benefits (see Fig. 26.2). Adoption of water- and nutrient-smart practices supported by CSA credit schemes will be enhanced if greater certainty on expected revenue streams can be guaranteed (Yegbemey et al. 2014). Investments in CSA infrastructure also can be supported through interlinked insurance systems (Brick and Visser 2015). For some CSA interventions, such as drought-tolerant maize varieties, widespread adoption may well occur without much development of financial markets.

Rural finance for CSA upscaling is heavily dependent upon the combined offer of finance, technical assistance and business support services. It also requires improved financial literacy among farmers. Smallholders usually lack bookkeeping and business-planning skills that would enable them to make more informed investment decisions. They also tend to lack the knowledge of insurance products that would allow them to manage production at the required scale (Branca et al. 2012).

Investments also must be made at different scales (farm, village, landscape and region). Whereas many CSA investments take place at the farm level, it is equally important to support infrastructure (in roads, irrigation, energy, etc.) that benefit larger communities and thus create the enabling conditions for CSA upscaling (Lipper et al. 2018). Also crucial is a supportive business environment that protects property rights and market incentives (Branca et al. 2012). Moreover, participation by different social actors and engagement of multi-stakeholder networks in the development of inclusive financial services is a key condition for broadly anchoring these CSA initiatives.

The interconnectedness of finance modalities (credit, savings, insurance) supports the different pathways towards CSA adoption. These linkages also might help ascertain the real impact of local rural finance on CSA outcomes (see Fig. 26.2). Common approaches for measuring the net effects of climate-smart input intensification (pathway 1) are usually based on the comparison of sites with and without CSA credit by means of the matching of households and assessing income and yield differences. Assessment of CSA capital investments (pathway 2) could be complemented by more dynamic analyses of household resource allocation (using bio-economic farm household simulation models) that provide insights into the implications of changes in the expenditure patterns for CSA investments. This could also inform decisions on resource allocation in non/off-farm activities that result in improved expenditures and enhanced farm-level investments in CSA practices. Finally, changes in risk behaviour (pathway 3) can be analysed by using experimental designs that offer insights into farmers' willingness to invest in CSA practices. A more forward-looking analysis of finance impact would also need to consider changes in attitudes toward risk that influence both intra-household resource allocation and extra-household supply-chain linkages. These behavioural changes are considered to be crucial for supporting long-term CSA resilience.

26.5 Implications for Development

A broad and scalable process of climate adaptation will require comprehensive interventions that both improve income and change attitudes toward risk. At the regional level, it is important to make use of the identified complementarities in rural finance systems that generate multipliers through simultaneous changes in expenditure patterns and risk attitudes. The latter changes tend to have more long-term implications and favour continuous engagement by farmers in CSA investments beyond increasing short-run profitability. Upscaling of CSA practices can thus be encouraged by systematically linking credit, savings and insurance products that influence different dimensions of the rural farm household decision-making structure. In addition, the effectiveness of finance products in fostering CSA adaptation depends heavily on the wider institutional, policy and market environments (Ruben et al. 2007). Therefore, local rural finance should be embedded in a framework of financial intermediation involving multiple stakeholders.

Our literature review suggests a number of strategies for better tailoring local rural financial products and services towards CSA anchoring:

- A broad use of CSA practices cannot be based on single financial products but requires the development of integrated financial markets.
- Effectiveness of rural finance for CSA upscaling is heavily supported by the combined offer of finance with technical assistance and business support.
- Prospects for scaling of CSA practices increase alongside coherent public investments in market development and institutional arrangements.

- Combined public and private sector engagement in CSA investments may have an additional payoff since such joint efforts also contribute to a more resilient business climate.
- Blended finance can take shape in the form of softer financing conditions for climate-smart investments (e.g., risk-sharing, risk layering, interest rates rebates and longer repayment periods), performance clauses and prohibitions, and combinations of finance with subsidized interventions (e.g., training, technical assistance, business development services and certification).

Rural finance plays a double role in CSA anchoring, both supporting individual farm-households as they adopt CSA practices and encouraging the local and regional business climate to favour CSA production systems that deliver credible outcomes.

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