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Growing Support for Climate-Smart Agriculture by Scaling Up Farmer and Climate Field Schools: Recommended Policy and Institutional Reforms

Key Messages

- Climate smart agriculture (CSA) consists of more than 70 technological and behavioural changes that can help farmers mitigate and build resilience to climate change while generating sustainable yields.
- Despite this wealth of alternatives, CSA has not been adopted at large enough scales to realise its considerable promise.
- Studies explaining the lack of progress often cite difficulties farmers face in acquiring information and knowledge as a key barrier to adopting CSA. Others point to policies and institutions that favour resource-intensive agriculture over more sustainable farming practices.
- Recent work on transforming food systems suggests policies and institutional reforms as well as integration of technical information and experiential knowledge can help overcome these barriers. However, this work sheds limited light on precisely which policy and institutional changes can help farmers convert information and knowledge into acceptable CSA practices.
- This brief presents four concrete recommendations on which policy and institutional reforms can help farmers translate technical information and experiential knowledge into context-appropriate mixes of CSA options in developing countries.
- The first recommendation focuses on promoting farmer field schools (FFS) or climate field schools (CFS) to enable farmers to meaningfully participate in selecting

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combinations of CSA options.

- The second recommendation involves standardising monitoring protocols, building relevant training capacities, and boosting funding to support the spread of FFS and CFS.
- The third recommendation entails integrating CSA in nationally determined contributions (NDCs) and similarly motivated climate policies to help enhance monitoring, bolster capacities, and expand funding for FFS and CFS.
- The final recommendation concentrates on strengthening links between proposed reforms, agricultural extension programmes and other sectoral policies to help spread knowledge from FFS and CFS across administrative tiers and policy spheres.

I Introduction

Climate change has placed many of the developing world's farmers and agricultural policymakers in an unenviable position. On one side, they face increasing temperatures, changing precipitation patterns, intensifying water scarcity, and growing pests and disease outbreaks that pose serious threats to crop yields and agricultural livelihoods. On another, they confront mounting pressures to alter land-use and cropping practices in order to curb greenhouse gases (GHGs). Approximately a decade ago, the Food and Agricultural Organization (FAO) coined the term climate-smart agriculture (CSA) to describe the policies and practices that could help policymakers and farmers mitigate and build resilience to climate change while also ensuring a sustainable food supply (FAO, 2010).

Over the past decade, researchers have identified more than 70 measures with the potential of achieving some of CSA's main objectives of climate resilience, climate mitigation, and food security (See Appendix 1 and Rosenstock 2019). Despite this wealth of alternatives, CSA has not been adopted at large enough scales to realise its considerable promise.

Explanations for this limited progress tend to fall into a few groups. One set of studies highlights difficulties farmers face in acquiring *information and knowledge* (including information on relevant costs) associated with adopting CSA. Other studies points to agricultural, economic and other sectoral *policies and institutions* that favour resource-intensive agriculture over more sustainable agricultural practices. Recent work on *transforming* food *systems* suggests adapting policies and institutions to fit productive landscapes (landscape approaches) or larger tracts of land (territorial approaches) can help overcome some of these barriers. Another system level argument maintains that complementing farmers' experiences with expert's technical knowledge are critical to altering policies and institutions. These system-level arguments suggest that policy and institutional reforms as well as the integration of technical information and experiential knowledge can overcome barriers to CSA. However, this work sheds limited light on precisely which policy and institutional changes can help farmers convert information and knowledge into acceptable CSA practices.

This policy brief offers recommendations that specify which policy and institutional reforms can help farmers translate technical information and experiential knowledge into context-appropriate mixes of CSA options in developing countries. The first recommendation concerns promoting farmer field schools (FFS) or climate field schools (CFS) to help farmers meaningfully participate in selecting combinations of CSA options. The second recommendation involves standardising monitoring protocols, building relevant training capacities, and boosting funding to support the spread of FFS and CFS. The third recommendation entails integrating CSA in nationally determined contributions (NDCs) and similarly motivated climate policies to help enhance monitoring, bolster capacities, and expand funding for FFS and CFS. The final recommendation concentrates on strengthening links between proposed reforms, agricultural extension programmes and other sectoral policies to help spread knowledge from FFS and CFS across administrative tiers and policy spheres.

The remainder of this policy brief is divided into five sections. The next section discusses the impacts of climate on agriculture and vice versa. A third section describes several CSA options. A fourth section outlines institutional and policy reforms to facilitate the spread of FFS and CFS. A final section concludes by reiterating arguments, reflecting on their limitations, and offering insights on the brief's implications for other policy areas.

2 Climate Change and Agriculture: Impacts and Contributions

The already significant impacts of climate change on farmers and food systems appear likely to become worse if current trends continue. The most obvious impacts are from increased temperatures; warmer weather is likely to accompany steep reductions in agricultural yields, most notably for wheat, maize and rice (IPCC, 2014). Moreover, food loss caused by drought in the agricultural sector—partially attributed to climate change—is a mounting problem. Projections that 169 countries are currently affected by land degradation, desertification or drought, with upwards of 80 percent of this damage in the agriculture sector, further underscores the magnitude of the challenge (Wagner, 2019; FAO, 2018).

Climate change not only adversely affects agriculture; growing, fertilising, transporting, and consuming food (along with food loss and food waste) also contributes to climate change. Climate researchers typically group food production under wider agriculture, forestry and land-use (AFOLU) activities. AFOLU accounts for approximately 24 percent of net-CO_2 emissions (IPCC, 2014) with equal shares for agriculture and land use (Richards, et al., 2019). AFOLU is also the largest source of anthropogenic non-CO_2 emissions, most notably methane and nitrous oxide, accounting for as much as 14 percent of total global emissions (IPCC, 2014; Stern 2007). Such data make clear that development pathways must consider altering agricultural practices to stay within safe 1.5-2 degrees Celsius temperature goals (IPCC, 2018).

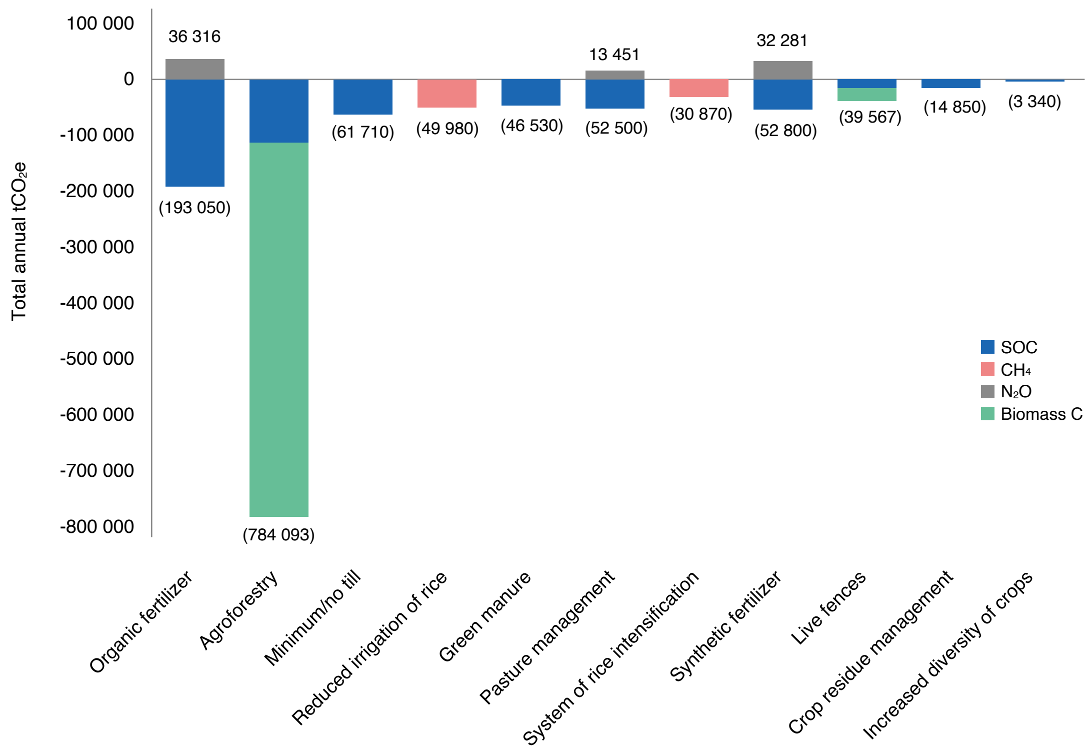
While climate change affects and is affected by agriculture, the primary motivation of agricultural policies and practices involves improving the production and allocation of food. Food security is critical because, even as obesity and related health problems grab headlines in certain countries, hunger and malnutrition remain persistent and pernicious problems in many corners of the world. Underlining this unfortunate reality are estimates that farming populations currently produce 75 percent of global food output yet comprise 80 percent of the world's poor; meanwhile, over 800 million people remain hungry, and upwards of 2 billion are afflicted with nutritional deficiencies (GEF, 2018). Recent data suggest that global food demand is projected to grow by as much as 50 percent by mid-century, but agricultural yields may contract by more than 30 percent if climate change continues unabated (Global Commission on Adaptation, 2019).

3 Climate Smart Agriculture Options: Toward a Context-Appropriate Mix

The more than 70 CSA options identified have different orientations and entry points. Some CSA practices focus chiefly on adaptation. A few illustrative examples include switching to resilient crop varieties and modifying farming techniques in line with different climate conditions (Smith, et al., 2007; Stern, 2007). Other alternatives with an adaptation focus involve investments in resilient infrastructure such as water saving irrigation systems, flood protection, and water storage (FAO, 2020; World Bank, 2017; Smith, et al., 2007; Stern, 2007). An additional set of options concentrates on extending public services and social safety nets to enhance the resilience of farmers and farming systems. Some examples include expanding agricultural insurance coverage (e.g. weather index insurance), promoting credit and financial assistance, and improving market access of key crops.

A second aspect of CSA are options that concentrate chiefly on mitigating GHG emissions. Some of the practices with the greatest mitigation potential involve sequestering carbon in soils. This can be achieved through, *inter alia*, conservation tillage, crop rotation, mixed cropping, soil nutrient cycling, and agroforestry (Rathore and Srinivasulu, 2018). Among these alternatives, agroforestry has the greatest mitigation potential (see Figure 1). Combining agroforestry and some of the other listed practices with techniques that improve soil carbon content such as biochar production can also enhance low-fertility soil and thereby increase mitigation capacity (Richards, et al., 2019). Many other mitigation alternatives do not focus on soils but other crop inputs. Measures in this category range from introducing new cultivars (i.e., higher yielding and carbon sequestering plants), substituting carbon-intensive inputs with sustainable alternatives, and improving livestock and manure management, such as by making use of low emission animal feeds and biogas digestion (Smith, et al., 2007; Stern, 2007).

As the CSA concept implies, several measures simultaneously achieve mitigation and adaptation objectives while also delivering sustainable yields. An effective combination of options and practices have been shown to sequester carbon, enhance soil and water quality, reduce erosion, improve productivity, ultimately boosting resilience in the process (Rathore and Srinivasulu, 2018). Further, many CSA alternatives are intended for other purposes besides climate change; several options also deliver wider development benefits such as supporting sustainable land and watershed management practices, expanding crop diversity, reducing food loss, and delivering other co-benefits (FAO, 2018; UNEP, 2018; IPCC, 2018). In many cases, however, farmers and other stakeholders will need to bring together several CSA options to achieve the multidimensional goals that define the approach. In fact, one of the main arguments advanced in this brief is that achieving the full potential of CSA will require combining multiple solutions in a context-appropriate mix of options.



Negative values represent a reduction in GHG emissions (or carbon sequestration).
Positive values represent an increase in GHG emissions.

Figure 1 Total effect on GHG emissions of improved agricultural practices (2011-2014)

Source: Richards, et al., 2019

4 Limited Progress with CSA

On the surface, identifying a context appropriate combination of CSA alternatives may appear simple and straightforward. Indeed, as noted previously, there exists no shortage of CSA options. Yet research suggests that adopting and scaling CSA has been difficult. A wide body of evidence demonstrates that CSA has yet to be adopted at sufficient scale to deliver on its promise (Lan, et al., 2018; FAO, 2015).

The lack of progress is partially apparent in data that show rising levels of GHG emissions from the agriculture sector. Agricultural emissions have increased 14 percent since 2000, while some projections hold they could increase an additional 58 percent by 2050 without significant climate actions (WRI, 2019). It is equally evident in work that shows farmers, particularly small-scale farmers, remain among the most vulnerable groups to a changing climate. Studies also pointing to the lack of progress are continuing reports that climate variability and extremes remain a critical source of hunger and food crises across the world (Searchinger, et al. 2019).

Perhaps most tellingly, the limited progress on CSA is apparent in the work that shows a lack of understanding or uptake by both small scale and commercial farmers in developing countries. Though gathering baseline data has proven difficult, systematic survey research suggests that few farmers are willing or able to adopt the adaptation and mitigation elements of CSA. For instance, work in East and Southern Africa demonstrates that CSA has focused mostly on increasing productivity at 82 percent with 17.5 percent on adaptation and 0.5 percent on mitigation (Rosenstock, et al. 2019). Additional evidence in Kenya suggests that adoption rates are relatively limited, with the lowest (between 42 to 49 percent) among poorer strata of the farmers sampled (Cavanagh, et al. 2017).

Other indications of limited uptake of CSA focus on institutions and high-level policy statements. The Nationally Determined Contributions (NDCs) that countries have pledged under the United Nations Framework Convention on Climate Change (UNFCCC) to contribute to the Paris Agreement are a case in point. While there has been modest progress in how many NDCs refer to agriculture-related adaptation (67 percent) or mitigation actions (78 percent), a much lower number—less than 20% of the NDCs—mention CSA (GIZ, 2017).

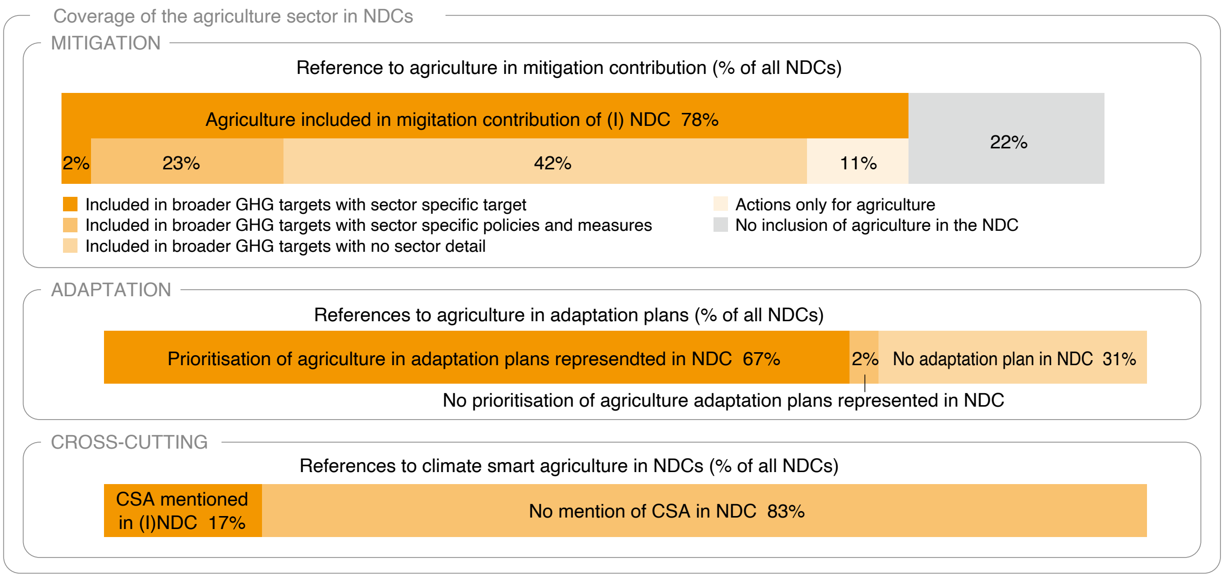


Figure 2 Overview of agriculture sector coverage in NDCs. Authors' own elaboration, based on FAO (2016b).
GIZ (2017) Sectoral implementation of NDCs[1]

[1] Though the data in this chart is based on 2016 INDCs, a review of INDCs/NDCs suggests that approximately 12 % of countries mention CSA as of 2020.

5 Barriers to Climate Smart Agriculture

The literature on the barriers to adoption of CSA has expanded greatly in recent years (Glover et al., 2016; Yameogo, et al., 2017). Several identified obstacles include information and knowledge constraints, while others involve broader institutional and policy impediments. This section discusses these informational/knowledge and institutional/policy obstacles and presents recommendations aimed at synthesising and further elaborating recent work focused on transforming food systems.

Many studies underline the limits of information as a sizable hurdle (Mullins et al., 2018). These knowledge gaps are critical because there can be a tendency to rely on "overly scientific language or jargon" when promoting CSA (Eidt et al., 2012). Knowledge gaps further merit attention because farmers may lack the data, time or resources to evaluate costs or whether different CSA measures result in greater yields (Acquah, 2011; McCarthy, et al., 2011; Steenwerth, et al., 2014). A related set of claims suggests the lack of technical "know-how" combined with a lack of investment can prevent the purchase of CSA technologies (Gledhill et al., 2012). An additional line of research underlines the importance of building farmers' capacity to work on CSA, with a view towards achieving more scalable impacts (Steenwerth, 2014).

Other arguments point to a need for wider policy or institutional changes. For example, some maintain that adopting CSA is not "a linear, binary and individual decision when...the dynamics [play out in a] much more complex" policy and institutional environment (Glover et al., 2016). For some observers, the uptake of CSA can be hampered by political economic institutions that favour maximising short-term production over long-term sustainability (Cavanagh, et al., 2017). Some of these institutional barriers may be overcome with targeted "enablers" such as input subsidies for CSA (Jayne et al., 2018). Others point to adopting more ambitious policy and institutional reforms: increasing finance, improving land tenure security, providing greater information, and expanding participation in decision-making to overcome barriers (Mullins et al., 2018). An additional set of claims that will be discussed later notes the need for institutional reforms that improve coordination between agricultural, climate change/environmental and food system policies and align climate and traditional agricultural finance to ensure enabling policies both support and allocate sufficient budget to CSA activities (Steenwerth 2014).

Another set of explanations focusing on food *systems*. These system level arguments suggest that information and institutions are critical components of a larger system, with implications that may either foster or frustrate reforms. These perspectives, however, differ on which parts of the system are most in need of change. Landscape approaches call for adapting policymaking institutions to reflect productive landscapes, enabling farmers and other stakeholders to manage resources at appropriate scales (Rawal, et al., 2019). Territorial approaches advocate changes to not only policymaking but also legal and financial institutions so farmers, businesses and other stakeholders can improve management of food and other resources across multiple landscapes (Cistulli, 2015; FAO, 2018). Recent variations of agroecology—a nearly 100 year old cross-disciplinary field of study—underline that combining farmer experience and technical expertise as part of ten point package of reforms that also includes more responsive governments at multiple levels can bring about transformation (FAO, 2019).

These explanations advance the idea that efforts to strengthen access to information can complement institutional reforms with a view towards transforming food systems. However, such accounts do not offer sufficient details on how information sharing can be combined with institutional and policy changes to support the uptake of innovative approaches like CSA. One way of building on these claims would be for landscape and territorial approaches to pay more attention to learning processes featured in agroecology. Another way of moving this discussion forward would be for agroecology to present clearer recommendations on ways to support knowledge dissemination across landscapes and wider regions as defined by landscape and territorial approaches. In short, policymakers arguably need more concrete recommendations on the types of policy and institutional reforms that can help farmers convert information and knowledge into context-appropriate mixes of CSA options across different levels and scales.

6 Scaling Up Farmer and Climate Field Schools

The first set of concrete reforms aimed at facilitating the uptake of CSA practices involves farmer field schools (FFS). FFS were piloted in the 1980s in Indonesia following a recognition that conventional agricultural extension pest management programmes were not adequately addressing farmers environmental, safety and health needs (Braun & Duveskog, 2008). Since their introduction, FFS have emerged as an important testing ground and living laboratory for achieving multiple agricultural goals in diverse contexts. These include enhancing the efficiency of livestock production in Kenya; improving the quality of aquaculture in Guyana; and supporting the integration of smallholder value chains in Kyrgyzstan (Braun & Duveskog, 2008; Hanf & Gagalyuk, 2018). Over the past decade, the participatory methods used in FFS are also increasingly being applied to build knowledge on climate change; in some cases, FFS that focus on climate change are called “climate field schools” (CFS) (Stigter, 2008).

A noteworthy feature of FFS and CFS is that they seek to engage farmers in learning activities and processes that encourage the adoption of improved farming practices. Importantly, FFS/CFS promote learning by moving away from the one-way transfer of technology, inputs, and information from agronomists to farmers in agricultural extension service approaches. Such unidirectional channels often failed to gain traction because they did not consider the pivotal role that collaboration and engagement play in learning. In contrast, FFS/CFS employ experiential education methods that blend local and technical knowledge, enhancing the ability of farmers to think critically and make informed decisions on priority issues, including climate and food security. Toward that end, FFS and CFS curricula focus on group activities that are structured to evaluate problems, identify alternatives, build consensus, and implement solutions via a cycle of continuous and iterative learning and improvement. This approach, which addresses the need to integrate indigenous and scientific perspectives in the recent work on agroecology, is well-suited to helping farmers identify a context-appropriate mix of options (FAO, 2016). FFS and CFS therefore need to be actively promoted to support the uptake of CSA.

A second set of reforms involves expanding the coverage of FFS and CFS in countries. FFS and CFS exist in some form in over 90 countries and have enjoyed success in countries such as Philippines (Chandra, et al. 2017). However, a closer look at the empirical track record shows that CFS and FFS—much like CSA—have spread far (across many countries) but not deep (within many countries). Table 1 presents a review of more than ten cases of FFS. While not exhaustive, the table presents a regionally and thematically diverse range of examples. Six cases focus chiefly on CSA; others highlight issues that are relevant to CSA. The surveyed cases include using FFS in Cameroon and Jamaica to promote agroforestry practices as well as encouraging the replacement of emissions-intensive inputs, such as fertilizers and pesticides with more biofriendly alternatives in Ecuador, Nepal, and Uganda.

Taken together, the results of the review in Table 1 show that there are cases where FFS and CFS successfully led to a change of practices in a specific locale. There are nonetheless fewer examples of successful scaling of those changes beyond a targeted area. To be fair, making this judgement is difficult because the case study literature can use different measures of success, ranging from the adoption of a new practice to a change in crop yields. Yet, even with this important caveat, the reasons for the limited signs of CFS and FFS parallel the policy and institutional challenges to CSA more generally.

More concretely, many of the cases in Table 1 also indicate several policy and institutional issues have consistently impeded the scaling and replication of FFS. The most frequently cited challenges include a lack of standard monitoring protocols, human resource constraints, and budget limitations. A discussion of these three obstacles and recommendations to overcome them follow.

Table 1 Challenges to Scaling FFS, CFS and Related Cases

Region	Country	Case Example	Challenges for Scaling	Reference
Asia-Pacific	Indonesia	FFS-led, "Science Field Shops" focused on agrometeorological learning were established in 3 locations across Indonesia (Yogyakarta, West Java, East Lombok) between 2008-2014 with the aim of improving farmers' adaptive capacity to climatic variability	• *Insufficient government support* • Weak cooperation between scientists and policymakers	Winarto, et al. (2017)
Africa	Cameroon	FFS curriculum was implemented under a wider public private partnership programme between 2002-2010 supporting agricultural innovation in national cocoa production systems	• Difficulties with accommodating FFS curriculum in existing agricultural extension services • *Lack of finance* • Lack of ownership among extension actors	Muilerman, et al. (2018)
Latin America	Ecuador	25 FFS were piloted in Carchi in 1998 as a means of improving pest management and herbicide use	• Conflict between national extension and FFS curricula • *Lack of long-term investment*	Sherwood, et al. (2014)
Asia-Pacific	Nepal	FFS have been operating since 1990 promoting integrated pest management under the direction of the Ministry of Agriculture	• Lack of effective knowledge dissemination	Tiwari (2013)
Africa	Uganda	FFS were promoted in 3 districts (Busia, Kabermaido, and Soroti) under a larger IFAD-FAO led project focused on integrated production and pest management (IPPM) between 1999-2008	• Overlap with national agricultural advisory programme	Davis, et al. (2010)
Asia-Pacific	Viet Nam	Using a FFS-approach, 310 "Farmer Livestock Schools" were delivered on a pilot basis in 36 communes, training upwards of 7,400 small scale and 500 commercial farmers between 2000-2007	• *Human resource constraints* • *Budgetary limitations* • Lack of long-term political commitment	Minh, et al. (2010)
Latin America	Peru	Supported by FAO, FFS on integrated pest management have been implemented in cooperation with public and private sector institutions	• *Lack of quality assurance and monitoring* • *Insufficient budget*	Groeneweg and Tafur, (2003)
Global	Global	Literature review shows short-term evaluations of pilot programmes have shown success but limited evidence that neighbouring non-participant farmers benefit from diffusion of FFS	• Training and capacity building suitable for shorter time frames • *Limited application of rigorous evaluation methods*	Waddington, et al. (2014)
Global	Global	Review of 25 impact assessments of FFS shows that there are substantial immediate benefits, but evidence of long term or scalable impacts is limited	• *Limited application of rigorous evaluation methods*	van den Berg (2004)

Region	Country	Case Example	Challenges for Scaling	Reference
North America	Jamaica	Demonstrates success of using farmer field school to increase adaptive capacity for limited number of farmers	• Low levels of participation	Rhiney and Tomlinson (2017)
North America	Central Arizona	Review of adaptive capacity for agricultural communities shows willingness and interest to learn how to transform with climate change	• *Limited human resources and capacities*	Eakin, et al. (2015)

Monitoring. A key issue affecting the performance and expansion of CFS/FFS activities concerns the absence of systematic measurement and reporting mechanisms. As outlined in Table 1, the lack of sound monitoring protocols undercut the delivery and quality assurance of FFS and CFS across countries such as Viet Nam and Peru. To better track performance, a growing number of governments have been moving towards localising agricultural and climate information services in existing extension systems, including by introducing the use of information and communications technology (Davis and Franzel, 2018). Similar farmer-to-farmer extension programmes that other countries are adopting as part of a wider process of administrative decentralisation could help to track progress (Musabanganji, et al., 2016; Davis and Franzel, 2018). In all cases, FFS/CFS would benefit greatly by harmonising monitoring programmes at the national and subnational levels.

Human resources. Another bottleneck to scaling is a lack of quality training for FFS/CFS. Many countries report critical shortages in agricultural extension personnel, much less service providers with the necessary skills to advise farmers on climate and environmental risks. With irregular extension visits to farmers cited as a key barrier to the adoption of climate smart behaviour (Henri-Ukoha, et al., 2018), there has been an increasing emphasis on the promotion of “pluralistic” approaches to agricultural advisory services and training in order to address capacity gaps (Diesel and Miná Dias, 2016). As highlighted in Table 1, governments ranging from countries such as Indonesia, Cameroon and Ecuador have made efforts to pilot innovative partnerships and arrangements with international development agencies, private bodies, civil society associations and others. Although not always successful, collaboration with different stakeholders in identifying ways to mainstream FFS in extension programs and curriculum can help close training and capacity gaps.

Budget. Despite a cumulative increase in the allocation of public expenditures to agriculture over the years, agricultural budgets remain low in comparison with overall spending across many countries (Anisimova, 2016). Faced with limited resources, governments often must choose between competing priorities for public funds. Consequently, while overall figures have increased, per capita investment in agriculture and its share of total government budget have effectively declined in many developing countries, especially in Africa and Latin America (Anisimova, 2016; IFPRI, 2019). Foreign direct investment inflows to agriculture have followed a similar downward trend in these regions (Goyal and Nash, 2016). To some extent, these gaps can be addressed by harnessing international development assistance and other sources of climate finance for promoting CSA (following examples from Uganda and Peru). Supplementing existing domestic and private initiatives with international donor support for FFS/CFS implementation is likely to be particularly important for least developed countries.

In many cases, the three areas of monitoring, capacity and funding should be addressed together since they are closely interrelated. For example, boosting capacities to support CFS and FFS will also help to enhance assessment and monitoring of outcomes. Improving monitoring can open opportunities for securing additional funding. Supplementary funding can lead to increases in the numbers of certified trainers. The next set of recommendations for wider sets of policy and institutional reforms can also help reinforce the recommended interventions.

The third set of wider reforms could begin with incorporating CSA in the NDCs and other climate policies and strategies. Making these links clear would help in strengthening monitoring and supporting the allocation of additional resources for many of the previously mentioned capacity and funding needs. As noted earlier in the brief, many countries have acknowledged the relationship between climate and agriculture in their NDCs but far fewer have made the connection to CSA. Incorporating CSA, with its emphasis on achieving multiple objectives, is a logical step forward as countries revise their NDCs.

Similarly, policymakers would be well-advised to carry out these policy reforms in line with the additional institutional and structural reforms illustrated in Figure 3. Such reforms include strengthening coordination between line ministries responsible for the environment, often including climate, as well as agriculture at the national level. Other efforts to increase cooperation between local government agencies with environmental and agricultural remits will also be important. Equally critical will be encouraging engagement between other stakeholders involved in climate change, agriculture, and agricultural extension programmes constituting parts of the enabling environment as depicted in Figure 3.

The above reforms recognise that there may already be coordination and collaboration within and between levels of decision-making on agriculture and climate. However, such interactions could focus more on facilitating institutional learning and understanding that would lead to greater recognition of CSA in NDCs and national policymaking. Doing so could potentially contribute to increasing flows of climate finance for CFS and FFS, thereby helping to identify, adopt and spread context-appropriate combinations of CSA options.

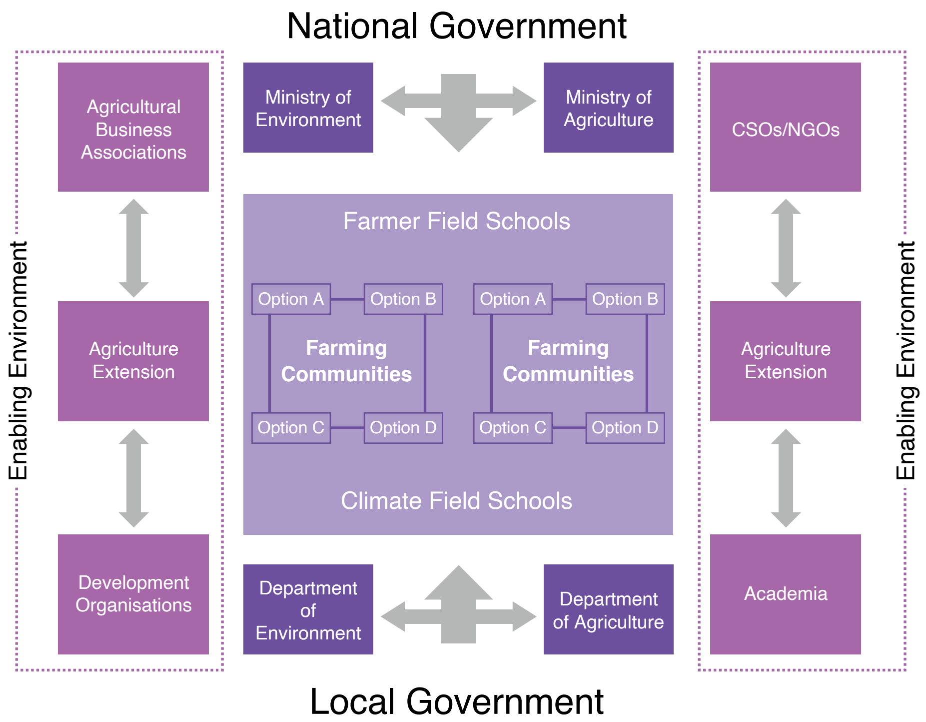


Figure 3 **Illustrating Recommended Institutional Reforms**

While the proposed reforms will require working across and between institutions, national authorities will often need to take the lead in setting the overall direction. For example, the national government can advocate mainstreaming of FFS/CFS into extension and advisory services by establishing a supportive institutional framework that outlines a clear division of responsibilities at various levels. At the same time, efforts to meaningfully engage with existing institutions, such as national agricultural associations and their local subsidiary bodies, training agencies and other service providers, will also be useful. Bringing these existing organisations into efforts to help communities arrive at context-appropriate combinations of CSA interventions will not only save resources, but also reduce potential opposition from incumbent actors and organisations. These reforms may also require a phased approach, which may seem more challenging than it appears in the organisational diagram outlined in Figure 3. At the same time, as illustrated by the example in Box 1, there are existing cases that demonstrate where similarly motivated reforms focused on social and gender considerations have been implemented in a step-by-step manner successfully.

BOX 1 Inclusion in Climate Smart Agriculture in India: The Case of the Women Farmer Empowerment Programme

Facing escalating food demands for a population expected to reach nearly 1.7 billion by the year 2050 (UNDESA, 2017), the Government of India has taken proactive steps to enhance the resilience of its agricultural sector at the national and local levels. Part of these efforts has involved Indian federal and state authorities mainstreaming participatory approaches into agricultural extension services—including through FFS programmes. India's environmental efforts have also created strong partnerships between government and civil society organisations advocating on behalf of disadvantaged groups to help sustain inclusion and achieve success at scale (Singh, 2014).

A clear example of this achievement is the Women Farmer Empowerment Programme or "Mahila Kisan Sashaktikaran Pariyojana (MKSP)" (translated as "strengthening women farmers" in Hindi). The Women Farmer Empowerment Programme has sought to empower 80 percent of all economically productive women who make up over a third of the labour force (Centre for Environmental Education, 2016). Initially, many of these women were unpaid labourers engaged in family farm enterprises who lacked access to extension services or necessary inputs to increase the value-added of their farms. The Women Farmer Empowerment Programme helped enhance the skills and competencies of female farmers to provide more sustainable livelihood opportunities, including by providing targeted investments designed to improve productivity and encouraging female participation in agricultural decision making. Some 3,000 community resource officers engaged 250,000 female farmers across the country to promote more sustainable agriculture practices among other sectoral concerns (Government of India, 2016).

A final recommendation involves mainstreaming FFS content and methods into other government-supported CSA-related training and education programmes, such as vocational and tertiary education curricula. Such actions should go hand-in-hand with efforts to examine the existing barriers to CSA stemming from a lack of policy and institutional coordination between climate and agriculture, education, trade, fiscal, financial and innovation policies and programmes and their respective implementing agencies. Simultaneous reforms to these related policy areas would also focus on removing identified barriers and facilitate the dissemination of CSA knowledge across administrative levels and policy areas.

7 Conclusion

The world's farmers and agricultural policymakers are at a crossroads. Without a re-orientation of current development patterns, farms will continue to rely on high-input, resource-intensive forms of cultivation. The adverse impacts of staying this course cannot be overstated: a failure to transform food systems could prove catastrophic for farmers and make living within planetary limits impossible. A growing recognition of these consequences has led to calls for adopting CSA practices. In fact, studies have documented more than 70 different options with potential for delivering on CSA's objectives of mitigation and adapting to climate change while also producing sustainable yields. Nevertheless, while there is no shortage of alternatives, the scale of CSA implementation has been insufficient in most parts of the world.

The main purpose of this policy brief was to propose recommendations for agricultural and climate policymakers in developing countries to expand the uptake of CSA. The brief has outlined a set of policy and institutional recommendations aimed at growing support for CSA by scaling up FFS and CFS. More concretely, the brief recommended actively promoting and boosting the monitoring, capacities, and funding for FFS and CFS. It has also called for set of policy and institutional reforms for establishing a supportive enabling environment for scaling FFS and CFS. This includes incorporating CSA in NDCs and strengthening coordination between relevant agencies and national and subnational authorities on CSA.

The recommendations in this brief draw on relevant literature but may not be free of limitations. One possible shortcoming is the lack of discussion of financial barriers to CSA. The brief recognises that some significant concerns raised by farmers may, at least initially, relate to the higher marginal costs of CSA practices. These issues warrant careful attention: as put forward by this brief, one of the central goals of CSA is to enhance the farmer's livelihoods. Indeed, efforts to promote CSA that disregard such concerns are unlikely to gain support. At the same time, a key reason this brief emphasises the integration of different knowledge systems is to support a selected mix of CSA options which are both cost-effective and financially feasible. Ultimately, the effective scaling of CSA practices can lead to policy and institutional changes that will, in turn, make CSA more affordable.

While the brief has focused on CSA, its arguments may have implications for other policy areas where there is unrealised potential to achieve climate and related development priorities. For example, there is growing emphasis on nature-based solutions to climate change and related development challenges. In these cases, it may also be critical to foster inclusive learning environments and build them into more integrated institutional arrangements to support their scaling. Future research may examine the possible applications and refinements to the recommendations made here to additional multi-objective policy concerns. This would also have useful implications for efforts to move forward integrated and inclusive approaches to the Paris Agreement and the Sustainable Development Goals (SDGs).

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Appendix

AGRONOMY	
Conservation Agriculture	Conservation agriculture
Soil amendments including organic and inorganic fertilizer	Organic + Inorganic
	Inorganic inputs (NPK)
	Compost
	Manure
	Green manure
	Biochar
	Integrated soil fertility management
Fertilizer application method	Fertilizer banding
	Microdosing
	Subsurface fertilization
	Precision agriculture
Crop Rotations	Crop order or sequence
	Crop combination
Intercropping	Intercropping with Legumes
Mulching	Plant residues
	External material
Tilling	Reduced till
	No till
pH control	Liming or Ca
Crop Tolerance to Stress	Heat tolerance
	Drought tolerance
	Salinity tolerance
Diversification	Increased diversity of cultivars
	Increased diversity of crops
	Increased diversity in rotation
	Polyculture system
Water management in upland soils	Drip irrigation
	Water harvest/storage
	Deficit irrigation
	Zai (Small pit in degraded land, filled with manure/compost/nutrients before rainy season to capture water and grow plants)
	Alternate partial root zone irrigation
Water management in flooded rice systems	System of Rice Intensification (SRI)
	Alternate wetting and drying (AWD)
	Mid-season drainage
AGROFORESTRY	
Boundary planting	Boundary planting
	Evergreen agriculture
Farmer managed natural regeneration	
	Farmer managed natural regeneration
Intercropping	Rows/alleys (N-fix)
	Rows/alleys (non-N-fix)
	Rows/Alleys (Multiple species)
	Mixed
	Parklands
Multi-strata agroforestry	Multi-strata
LIVESTOCK AND AQUACULTURE	
Diet management	Non-conventional feeds
	Improved protein content
	Improved use supplements
Improved pasture	Planting N fixing legumes
	Fodder Shrubs
	Introduction of suitable non-native fodders
	Increased pasture palatability and acceptability
Rangeland Management	Carrying-capacity improvement
	Rotational grazing
	Cut-and-carry
Manure management	Manure collection
	Manure storage
	Manure treatment
Destocking	Destocking
Genetic improvement	Hybridization
	Assisted reproduction
	Changing breeds
Aquasilviculture	Integrated Multitrophic Aquaculture (IMTA)
	Aquasilviculture
Disease Management	Disease resistant breeds
	Biological control of vectors
POSTHARVEST MANAGEMENT	
Harvesting Technique	Alternate harvesting techniques
	Changing harvest time
Improved storage	Improved drying techniques
	Improved preservation
	Improved physical storage
FOOD ENERGY SYSTEMS	
Biogas	Biogas production
Improved cookstoves	Improved cookstoves
OTHER	Market and enterprise development
	Rehabilitation and expansion of rural roads

Source: Based on Rosenstock, 2019

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