Climate Smart Agriculture: Challenges and Opportunities

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INTRODUCTION

Introduction

Overview of Climate Smart Agriculture

Climate-smart agriculture (CSA) may be defined as an approach for transforming and reorienting agricultural development under the new realities of climate change. The most commonly used definition is provided by the Food and Agricultural Organisation of the United Nations (FAO), which defines CSA as an integrated approach to managing landscapes—cropland, livestock, forests and fisheries—that addresses the interlinked challenges of food security and accelerating climate change. CSA supports reaching internationally agreed goals such as the SDGs and the Paris Agreement. CSA aims to simultaneously achieve three outcomes:

- **Increased productivity**: Produce more and better food to improve nutrition security and boost incomes, especially of 75 percent of the world's poor who live in rural areas and mainly rely on agriculture for their livelihoods.
- **Enhanced resilience**: Reduce vulnerability to drought, pests, diseases and other climate-related risks and shocks; and improve capacity to adapt and grow in the face of longer-term stresses like shortened seasons and erratic weather patterns.
- **Reduced emissions**: Pursue lower emissions for each calorie or kilo of food produced, avoid deforestation from agriculture and identify ways to absorb carbon out of the atmosphere.[1]

CSA is not a set of practices that can be universally applied, but rather an approach that involves different elements embedded in local contexts. CSA relates to actions both on-farm and beyond the farm, and incorporates technologies, policies, institutions and investment.

Different elements of climate-smart agricultural systems include:

- Management of farms, crops, livestock, aquaculture and capture fisheries to balance near-term food security and livelihoods needs with priorities for adaptation and mitigation.
- Ecosystem and landscape management to conserve ecosystem services that are important for food security, agricultural development, adaptation and mitigation.
- Services for farmers and land managers to enable better management of climate risks/impacts and mitigation actions.
- Changes in the wider food system including demand-side measures and value chain interventions that enhance the benefits of CSA.[2]

Importance and Impact of CSA

Need for Climate- Smart Agriculture

The need for climate-smart agriculture for the world's 500 million smallholder farms cannot be overlooked: they provide up to 80 per cent of food in developing countries, manage vast areas of land (farming some 80 per cent of farmland in sub Saharan Africa and Asia) and make up the largest share

[1] World Bank Climate-smart agriculture, 2021
[2] Overview | climate-smart agriculture | Food and agriculture organization of the United Nations, n.d.

of the developing world's undernourished. As the most vulnerable and marginalized people in rural societies – many of them are women heads of household or indigenous peoples – smallholder farmers are especially exposed to climate change. They inhabit some of the most vulnerable and marginal landscapes, such as hillsides, deserts and floodplains. They often lack secure tenure and resource rights. They rely directly on climate-affected natural resources for their livelihoods. There is growing acknowledgement that agriculture and food systems need to change, irrespective of climate change. The last time the world faced such pressure to find a permanent solution to world food insecurity was in the 1960s and 1970s, and the response was the Green Revolution.

The Green Revolution resulted in spectacular achievements, but its longer-term limitations are driving a rethinking of agricultural best practice. Its focus on monocropping and often-excessive use of agricultural inputs such as pesticides and fertilizers has resulted in poor soil quality, reduction of biodiversity, pest resistance, pesticide and fertilizer pollution in the environment (soil and groundwater) and human health risks. Overuse of irrigation water has resulted in salinization and/or a withdrawal of groundwater beyond its replenishment capacity. Besides the stagnation of crop yields, landscapes have been compromised through the overuse of groundwater, the spreading of nutrients and pesticides and encroachment of agriculture into ecologically fragile zones such as mountainous areas, forests and marginal lands.

About 1.2 billion hectares (almost 11 per cent of the Earth's vegetated surface) has been degraded by human activity over the past 45 years. An estimated 5 million to 12 million hectares are lost annually to severe degradation in developing countries. The causes include deforestation, biomass burning and agricultural practices such as repetitive tillage and inadequate application of nutrients. The worst affected is sub-Saharan Africa, where per capita food production continues to decline and hunger affects about a third of the region's population. Continued cultivation of marginal areas without adequate management is a major driver of widespread land degradation through deforestation, wind and water erosion, and overgrazing.

Climate change is adding pressure to the already stressed ecosystems in which smallholder farming takes place. Over the centuries, smallholders have developed the capacity to adapt to environmental change and climate variability, but the speed and intensity of climate change is outpacing their ability to respond. Such substantial climate change will further increase uncertainty and exacerbate weather-related disasters, drought, biodiversity loss, and land and water scarcity. The major cereal crops (such as wheat, rice and maize) are already at their heat tolerance threshold and with an increase in temperature of between 1.5° C and 2° C could collapse. The rise in temperature will, of course, have an impact not only on crops and livestock but also on the pests and diseases they are exposed to. Some farming systems will not remain viable because of climate change, requiring farming system shifts. These 'first-round' effects will be compounded by a second round of socio-economic impacts in terms of economic opportunities and political stability. [3]

A coherent response to climate change requires continued emphasis on multiple aspects of agriculture, economy and the environment. This can include country-led development, community-based natural resource management, gender awareness, targeting of poor rural people, dealing with

[3] International Fund for Agricultural Development (IFAD), 2011

land tenure issues, improving access to financial services and markets, increasing sustainable productivity, and institutional and human capacity-building.

What is new about CSA is an explicit consideration of climatic risks that are happening more rapidly and with greater intensity than in the past. New climate risks, require changes in agricultural technologies and approaches to improve the lives of those still locked in food insecurity and poverty and to prevent the loss of gains already achieved. CSA approaches entail greater investment in

- Managing climate risks
- Understanding and planning for adaptive transitions that may be needed, for example into new farming systems or livelihoods
- Exploiting opportunities for reducing or removing greenhouse gas emissions where feasible. [4]

Impact of Climate- Smart Agriculture

The technical foundations of climate smart agriculture already exist. CSA's approaches focus on maximum use of natural processes and ecosystems, less external inorganic inputs and waste, diversity and proportionality of production and mixture of traditional and new technologies.

These approaches are described as 'multiple-benefit' because they typically build climate resilience alongside other benefits. They manage competing land-use systems at the landscape level, while at the same time reducing poverty, enhancing biodiversity, increasing yields and lowering greenhouse gas emissions. In many cases they are implemented as packages at the farm level. Taken together, they are examples of what is referred to as sustainable land management, sustainable land and water management, landscape approaches and watershed management, conservation agriculture, and rangeland management. Often, they also embrace the technique of integrated pest management and by design they are integrated systems of plant nutrient management. These approaches are knowledge-intensive and heterogeneous.

Supporting smallholder agriculture through CSA has benefits for emissions reductions that are in the interests of farmers themselves. For instance, planting acacia trees in maize fields in Africa has led to yields doubling, while the resilience of the soil to land degradation has been increased by improving its organic and nitrogen content, water retention capacity and microclimate moderation. At the same time, this is reducing soil carbon emissions by maintaining greenery and promoting tree growth and biodiversity, which provides a diversified habitat and a source of food for both wild and domesticated animals. Helping pastoralists manage land better can have a substantial impact on their livelihoods, but also on the reduction of greenhouse gas emissions

CSA projects around the world have resulted in multiple benefits and remarkable wins for farmers and the environment. For instance, in Colombia, the Mainstreaming Sustainable Cattle Ranching Project through the adoption of silvopastoral systems (SPS) resulted in participating producers transforming 38,390 hectares of pastureland to SPS. Compared to production areas without SPS, milk productivity increased by about 25%, cost of milk production decreased by 9% per liter, animal stocking rate increased by 26%, and farmer's income increased by as much as USD 523 per hectare per year. [5]

[4] CCAFS- Climate-smart agriculture, 2022
[5] World Bank- Climate-smart agriculture, 2021

CHALLENGES AND RECOMMENDATIONS FOR CSA

Challenges and Recommendations for CSA

Challenges

Inadequate availability of water resources: Water resources around the world are relatively limited. The global average water use for agriculture is around at 70 per cent. As water use rises for industrial purposes, stress on this natural resource could be a major impediment for future economic growth and job creation in a sustainable manner. The impacts of climate change on availability of water could further squeeze the prospects of sustainable economic growth. Moreover, many regions around the world already suffer from an acute water shortage, both for domestic use as well as for agriculture and industry.

For instance, in South Asia, per capita availability of water 1,217.27 m^3, which is low when compared with the rest of the world (6,122.56 m^3). Furthermore, due to the structure of the South Asian economies, utilization of water for agriculture is much higher than for the more developed economies of the world.

Occurrence of Natural Disasters: Every year natural disasters, such as hurricanes, floods, fires, earthquakes, and tornadoes, challenge agricultural production. Because agriculture relies on the weather, climate, and water availability to thrive, it is easily impacted by natural events and disasters. Agricultural impacts from natural events and disasters most commonly include: contamination of water bodies, loss of harvest or livestock, increased susceptibility to disease, and destruction of irrigation systems and other agricultural infrastructure.

These impacts can have long lasting effects on agricultural production including crops, forest growth, and arable lands, which require time to mature. Thus, there is a need to integrate disaster risk reduction as well as emergency response to disasters in the context of agriculture and CSA in the official strategy of development in countries.

Lack of adequate climate resilient infrastructure: Lack of adequate infrastructure is one of the limiting factors for economic growth and development in developing countries. Infrastructure needs to be expanded quickly, for which investments are needed. Apart from incorporating climate resilience in all investment decisions holistically, there is lack of infrastructure specifically to be able to deal with disasters, especially in those locations where climate vulnerability is high.

Small scale and irregular nature of CSA adoption: Current adaptation measures in the agriculture sector in response to climate change impacts in the developing world are sporadic and far from being integrated. Though both autonomous and planned adaptation measures have been implemented across various regions, a systemic improvement that would make the adaptation efforts proactive, particularly on governments' fiscal support to adaptation, is required given the projected increase in severity of climate change impacts.

Limited external support: Farm-specific adaptation measures are often implemented without the appropriate intervention of an external support. Planned adaptation programmes, formulated and implemented by various governments are presently not capable of transitioning into autonomous

adaptation options (particularly at the farming system-level and at the farming-community levels) in many countries and context, particularly in South Asia.

Inadequate emphasis on gender dimension: Women comprise an average of 43 per cent of the agricultural labour force of developing countries and women farmers often have a higher exposure to climate risks and less adaptive capacity because women farmers are poorer than their male counterparts and have insufficient assets (financial, technological, knowledge, natural and physical capital), fewer entitlements (rights, voice and access to institutions) and less mobility to help them with climate change effects

Investment and Opportunity costs related to land management: Most of the CSA techniques aim to improve soil quality (structure, fertility, water regulation), however, the benefits are often not appreciable for at least five years, while costs are borne immediately. These costs include opportunity costs of labour and land, as well as up-front cash outlays that many poor farmers simply cannot afford given thin credit markets and limited results available. Thus, they are the group facing the highest opportunity costs in adopting CSA.

Lack of knowledge and experience: Limited information available about alternative techniques as well as limited local experience with such practices that hinders adoption. This increases uncertainty and risks associated with adoption, exacerbated by the fact that insurance markets are even more thin – or non-existent – than credit markets.

Limited availability of inputs: Even where farmers might invest in certain techniques, inputs are often not available in local markets [6]

Recommendations

Increase availability and efficiency of water use for smallholder agricultural production and processing. This can be achieved through government actions and interventions in:

- Undertaking analyses of water use and distribution at the landscape level in light of changing trends in rainfall patterns to inform the design of sustainable systems agriculture production
- Using integrated water-resource management to maintain and improve and processing the healthy functioning of watersheds and to build resilience to climate change by combining watershed management with resilience-oriented land-use planning, climate-proof infrastructure, water users associations, water recycling and grey water use
- Adopting a range of water-harvesting techniques such as low-cost groundwater recharge methods, water-use-efficient irrigation systems and climate-proofed medium-sized reservoirs
- Implementing flood management through catchment source control to reduce peak discharges, using mini-dams and levees that are designed to contend with rainfall of a higher intensity and longer duration [7]

Integrate CSA into national development strategies for disaster risk management and to increase uptake among farmers: Governments could include climate information best management practices and promote inclusive planning and budgeting as part of their national strategies. This can be specifically achieved through:

[6] Sawhney & Perkins, 2015
[7] Sawhney & Perkins, 2015

- Conducting climate impact assessment to compile the existing and imminent climate hazard and vulnerability information can help in effectively integrating climate risk information into national policies, strategies, and regulations are a vital step in managing climate change risks.
- Developing local vulnerability assessments guidelines, tools, and best management practices (BMPs) are essential to inform district and local level planning. Disseminating impacts assessment findings and BMPs are also crucial. Moreover, two tasks are critical to systematic management and use of climate risks:
    - establishing a platform for national dialogue and information sharing on climate risks, delivering regular bulletins, information updates and policy briefs;
    - conducting learning and training programmes of national, regional, and district levels of technical staffs of diverse sectors such as agriculture, forests, rural development, water supply, disaster management
- Promoting inclusive planning and budgeting for reducing climate and natural disaster-related risks is indispensable to resilience, development, and (global) change. This can be done through:
    - Integrating climate risks into participatory planning and financing of small scale rural infrastructure provision
    - Improving technical capacity for district-level local assemblies to understand and integrate climate risk information, including climate-induced disasters, into local planning, budgeting, and budget execution. [8]

Ensure that rural infrastructure is climate-resilient: Governments could assess climate change impacts on existing key agricultural infrastructure in order to refine design and engineering specifications to keep pace with future impacts. This can be done though:

- Financing the building/retrofitting of rural infrastructure to cope with climate-related risks such as water shortages and extreme weather events, e.g. floods, erratic rainfalls, submersible roads
- Strengthening food security systems by improving storage and marketing facilities [9]
- Preparing district annual action plan and implementation, which combine climate resilience for rural infrastructure with ecosystem-based adaptation measures, is crucial.
- Small scale physical infrastructures have to take into account anticipated climate risks, for instance, droughts, floods, erosion, and landslides.
- Employing complementary soil and land management measures (e.g., slope stabilisation measures), and establishing and integrating codes and community-based emergency responses into existing infrastructures. [10]

Reorganize farm operations to solve the problem of scale: To improve uptake of CSA, there is an urgent need to solve the concern of the problem of scale. This primarily requires:

- Reorganizing farm operations, possibly into industry clusters to be organized with substantial government support. This concern is particularly true for South-East Asian countries as there is a need to open up discussion on the need to change land use patterns that must be supportive to the achievement of CSA and a low-carbon economy overall. [11]

[8] Roy, 2020
[9] International Fund for Agricultural Development (IFAD), 2011
[10] Roy, 2020
[11] Sawhney & Perkins, 2015

Increase institutional capacity for adaptation at local and national levels to provide external support to farmers. This could include:

- Building the capacity of local institutions to adapt to climate change and adopt agro-ecological farming models, including the capacity to identify and address agricultural systems that are simply not viable under conditions of climate change and will require farming system shifts
- Improving the clarity of governance structures dealing with climate-change related matters that have an impact on the rural sector and establishing linkages between relevant local and national government institutions
- Building expertise in agricultural research that is climate-change-oriented and in the provision of advisory and extension services
- Developing user-friendly data management systems and inter-sectoral coordination mechanisms (at national and local levels) for synergistic programme and project development and implementation in which responses to climate impacts have been harmonized across a range of sectors
- Strengthening health, food security and agriculture linkages in light of climate impacts, e.g. through a focus on nutrition
- Improving regulatory systems to provide incentives for the uptake of adaptation responses and climate-smart sustainable land management
- Improving access to 'green markets' and creating incentives for climate-resilient products (e.g. rooibos tea) [12]

Introducing cost effective mitigation strategies: At the farm-level, implementing CSA shows strong potential in reducing the impacts of climate change and thus would help sustain farm productivity. With the right financial support, primarily from the government, such conditions would still allow farmers to sustain farm productivity and achieve substantial income so they could gain capital that may enable them to invest in farm management options and infrastructure that would make them fully adapted to climate change

- For the government, financing CSA requires a mixture of public and private resources. Broadly, it needs scaling-up finance for climate-resilient infrastructure and mainstreaming climate resilience at the project investment level. The latter can be promoted through screening infrastructure projects for climate risks and integrating climate resilience into Public-Private Partnerships (PPPs)

Making agriculture gender sensitive: Understanding gender difference in access to climate-smart agricultural interventions and opportunities is essential to responding effectively to climate change. CSA should contribute to food security, adapt to and mitigate climate change and promote equality between men and women in a changing climate. The following are five concrete policy recommendations to make CSA gender smart:

- Conduct gender analysis within all CSA projects, programmes and policies to assess the implications and benefits of CSA technologies and practices on men and women.
- Identify women's groups and provide them with training and support for leadership, negotiation and communication skills, as well as business skills.
- Support women's participation in decision-making related to climate change, particularly at the local level.

[12] International Fund for Agricultural Development (IFAD), 2011

- Provide training to both men and women on CSA technologies and practices and gender awareness.
- Facilitate women's access to land and credit through transforming laws and local practices

Identifying and supporting champions of CSA: For CSA to fully take-off in developing countries, champions for its implementation need to be identified and supported. Here, farmers play a central role, being the main actors of agriculture implementation. However, the necessary roles of technocrats at national and local levels need to be enhanced, particularly in their capacity to support farmers to engage in CSA. To realize this, governments therefore must offer a good incentive system by, among other things:

- providing financial support to farmers implementing farm management practices and in utilizing technologies that help reduce GHG emissions;
- increasing support to research and development to identify better farm management options that would reduce carbon-emissions and specific farm practices aligned with CSA;
- assisting farmers making the transition to CSA; and
- rewarding and recognizing farmers supportive of climate change objectives, particularly those who operate under CSA goals

Improving farmers' access to inputs and farming technologies in order to harness multiple gains of climate change adaptation in agriculture: Climate change adaptation in the agriculture sector must be done in a way that would ensure sustained productivity of the farming sectors, while ensuring reduced emission of GHGs.

- Government planned adaptation programmes need to include provision of mechanisms that would improve farmers' access to lesser input costs, good agricultural practices, improved post-harvest technologies and opportunities to diversify income and livelihood sources, among others.
- On the other hand, better farming technologies that would be supportive for reduced GHG emissions need to be supported and, if possible, initially financed by the government. Incentive systems should be instituted by the government to further encourage farming systems to align with the CSA agenda [13]

Best Practices

Value chain projects should integrate climate risk analysis that identifies climate risks and adaptation mechanism. Climate risk analysis can be done through: selection of a viable value chain; identification of climate risks affecting the value chain; selection of appropriate adaptation measures; targeting to the most vulnerable; and identification of pathways to reach scale beyond the immediate project investment.

Effective climate adaptions can include the following three elements:

- **Diversification** - Inclusion of a wider set of options to increase farmers' livelihood, farming and environmental management portfolios as a risk management strategy
- **Climate-proofing** - Specific interventions to make key stages of the value chain more climate resilient in ways that bring livelihood and resilience benefits to farmers
- **Supply chain efficiencies** - Measures such as waste reduction or inventory management that increase efficiency, deliver higher profitability (and hence higher adaptive capacity in a general sense) to farmers and small businesses in the value chain, and generate mitigation co-benefits

Climate risk management can be scaled-up by maximizing the use of existing value chain links for climate information flow and diversifying value chains, so that they are not just about output markets

[13] Sawhney & Perkins, 2015

for farmers, but also include markets for inputs that promote climate resilience, such as drip-feed irrigation or drought-tolerant seeds

The project design stage should incorporate climate change strategies to ensure that project identification, design, and implementation are based on an understanding of climate change in a local context. Project design should integrate the assessment on impact of climate change on different categories of poor rural people, and women as compared with men. This can be done by including climate change alongside other relevant project risks and opportunities, particularly those related to environmental threats. This may require engaging with communities to assess specific climate-related risks to communities and to project success (and their financial implications); and then working with them to identify and analyse alternative project designs or approaches to reduce or eliminate these risks. Some of the steps to achieve this include:

- Increase staff knowledge of and sensitivity to the role of climate change issues, and their knowledge of experiences in and practical tools for building climate change into country and regional programmes and projects
- Appropriate integration of climate-related issues in project monitoring and evaluation and knowledge management systems, mid-term reviews, and supervision and project status reports

Projects can explore the possibility of providing climate insurance to farmers for specific climate events such as rainfall failure or drought, in order to reduce the risk for farmers. Parametric (or index-based) insurance products are insurance contracts that make payments based on the intensity of an event (for instance, hurricane wind speed, earthquake intensity, volume of rainfall) and the amount of loss calculated in a pre-agreed model. This is different from traditional insurance settlements that require an on-the-ground assessment of individual losses after an event. For instance, the Climate Risk Adaptation and Insurance in the Caribbean (CRAIC) project provided parametric insurance as a disaster risk management instrument in the Caribbean. A few good practices to be followed for climate insurance are:

- The target population should be educated on parametric insurance
- Basis risk (when the calculated measurements don't match the actual losses) must be understood by government, insurers, distribution channels, and the target population for parametric insurance to be accepted
- Microinsurance schemes should be aligned with national social protection policies and strategies
- The parametric models that underpin policies should be continuously improved to enhance product performance
- Local NGOs and Community-Based Organizations play an important role in lowering the cost of insurance
- Local insurers need to align climate risk microinsurance to their overall business strategy
- Microinsurance should be integrated into country and regional institutions to ensure sustainability

CSA: CASE STUDIES FROM ASIA AND AFRICA

CSA: Case Studies from Asia and Africa

Addressing Climate Change Vulnerability in Agriculture in Philippines

Agriculture and Climate Change

Philippines is vulnerable to the impacts of climate change due to its geographical location and archipelagic formation. The country ranks highest in the world in terms of its vulnerability to tropical cyclones, third in terms of people exposed to such seasonal events, and fourth among countries most affected by extreme weather events. Overall, climate change could cost the Philippines' economy approximately USD 520 million a year by 2050. Due to increased water and heat stress, climate change and variability is expected to decrease crop yields, increase the incidence of pests and diseases, and cause shifts in crop production suitability.

CSA Technologies and Practices

On farm: In the horticulture sector, farmers cultivating vegetables have been using adaptive crop calendars (i.e., an adjusted schedule for planting and harvesting, and other critical periods, based on weather forecasts) and stress-tolerant varieties (e.g. drought) given the low investment costs that these practices require.

In the fisheries sector, there is evidence of adoption of aqua-silviculture activities, organic aquaculture and communal stocking and rehabilitation of fish by some small-scale farmers. These practices are mostly associated with climate risk management but also have significant positive impacts on farm income and the sustainability of fish production.

Enabling institutions and policies for CSA

Government Institutions: The government prioritizes climate change adaptation which is reflected in a number of policies and institutions established and engaged in adaptation activities.

- The **Philippines' Climate Change Commission (CCC)** is the lead policy-making body responsible for coordinating, monitoring, and evaluating the country's climate change programs and action plans.
- **National Disaster Risk Reduction and Management Council (NDRRMC),** promotes activities to increase resilience to natural disasters (e.g., the use of early warning systems).
- **Department of Agriculture Systems Wide Climate Change Office (DA SWCCO)** acts as a catalyst, coordinating, and oversight body for the mainstreaming of climate change in agriculture. It also leads the resilient agri-fisheries sector initiative through Adaptation and Mitigation Initiative in Agriculture (AMIA) by supporting local communities to plan and implement strategies in managing climate risks in partnership with the RFOs

Policies: The Philippines is a global pioneer in mainstreaming climate change into its national laws and policies. As early as 1991, the Philippines promoted the creation of laws designed to promote increased productivity and adaptation in the face of climate change. Some major policies include:

- **Agriculture and Fisheries Modernization Act of 1997** (AFMA), officially designated as Republic Act No. 8435 required the Department of Agriculture or DA and other agencies to incorporate considerations of climate change, weather disturbances, and annual productivity cycles when formulating agricultural and fisheries programs. RA 8435 also mandated the DA to formulate

an Agriculture and Fisheries Modernization Plan (AFMP), specifically targeting food security, poverty alleviation and social equity, income enhancement and profitability, global competitiveness, and sustainability.

- **Republic Act 10121 (2010) and Republic Act 9729 (2009)**, both strengthen the institutional foundation for disaster risk management and climate change adaptation in the country. These laws establish local disaster risk reduction management mechanisms and enable the creation of disaster risk reduction management plans
- **National Climate Change Action Plan (NCCAP)** outlines the country's agenda for adaptation and mitigation for the period from 2011 to 2028. The objectives of the NCCAP related to food security are to ensure availability, stability, accessibility, and affordability of safe and healthy food in the face of climate change

Financing CSA

The People's Survival Fund provides financial support to CSA activities while the Philippine Crop Insurance Corporation (PCIC) is involved in the piloting of an innovative weather based crop insurance. The People's Survival Fund of the CCC supports Local Government Units (LGUs) and community organizations to implement climate change adaptation projects at the community level and serve as guarantee for risk insurance needs for farmers, agricultural workers, and other stakeholders. Projects include water resources and land management and infrastructure development. LGUs with high incidences of poverty, elevated exposure to climate risks, and that possess important biodiversity area are prioritized.

The Philippine Crop Insurance Corporation (PCIC) is currently piloting weather index-based insurance, where insured farmers are entitled to payments if Philippine Atmospheric, Geophysical and Astronomical Services Administration (PAGASA) rules that rainfall in a given area exceeds or falls below average indexed levels. To participate, farmers pay a 5% premium tied to the value per hectare of farmland.

Outlook

The Philippines has taken major steps in addressing climate change vulnerability and impacts through an ambitious policy and institutional framework that focuses on food security, resilience building, and disaster risk reduction. Further scaling up of CSA will depend on:

- Investments in water management and irrigation infrastructure to address crop yield gaps, Decentralized seed systems, seed buffer stocks, and the expansion of small-scale mechanization are necessary to improve crop yields.
- Efforts to establish integrated decision support structures and extension systems that compile and analyze weather, agronomic, and market information, delivering timely results to a range of stakeholders and decision makers.
- Additional national and international public and private resources to fill existing financial gaps for climate action. [14]

Building Resilience of Agriculture to Climate Change in Mali

Agriculture and Climate Change

The agriculture sector in Mali is sensitive to climatic stresses such as droughts and floods and recurrent droughts having led to major food shortages. Floods also occur due to periods of intense rainfall, particularly along the Niger River flood plains. The combination of droughts and floods can have a devastating effect. For example, in 2000 in Mopti and Gao (both along the Niger River) dry

[14]Climate-Resilient Agriculture in the Philippines, 2017

spells led to late planting of the area's rice crops, however floods followed shortly after planting resulting in loss of the seeds. Poor land management, overgrazing and encroachment of agriculture onto otherwise unsuitable land have resulted in siltation and erosion, which have increased vulnerability to floods and droughts

CSA Technologies and Practices

On farm: In Mali, a number of climate-smart practices have been prioritized. For crop production, the use of improved varieties that are drought tolerant and fast growing, composting, micro dosing, urea deep placement, soil and water conservation are among the key practices. For livestock, fodder production, feed supplementation and herd mobility are among the main CSA-related practices used by agro-pastoralists. Cattle fattening, through stall feeding and animal housing has also been promoted in the country.

Off farm: Off-farm CSA related practices are largely focused on the development of hydro meteorological information systems, particularly for hazard early warning but also for informing seasonal agricultural activities. For example, the National Meteorological Agency (Mali Meteo) is providing agro-meteorological assistance to rural communities, delivering accurate, timely and locally-adapted weather forecasts on various aspects, including beginning of the rainy season, length of the growing season, daily weather information, among other parameters

Within the framework of the West Africa Agricultural Productivity Program (2007-2013), the government has engaged in efforts to improve productivity and incomes of Malian farmers, by promoting CSA practices and technologies that yield better results for the smallholders, such as improved varieties of rice, stress-resistant tomato varieties (allowing production in the rainy season), seed drills for efficient planting, siloed maize production for fodder, among others. Approximately 175,000 farmers who used such technologies experienced average increases in yields and incomes by 30% and 34%, respectively.

Enabling institutions and policies for CSA

Government Institutions: The lead institutional actor for climate change work in the country is the Ministry of the Environment, Sanitation, and Sustainable Development (MEADD), which also acts as the Global Environment Fund (GEF) and Green Climate Fund (GCF) focal points. Other institutions include:

- The **Agency for Environment and Sustainable Development (AEDD, French acronym),** created in 2010, is mandated by the MEADD to coordinate climate mitigation and adaptation actions and serves as the secretariat for CNCCM
- The **Institute for Rural Economy** (IER, French acronym) leads the research on innovation and climate-smart technologies, contributing to the development of improved cultivars adapted to local conditions and participating in the capacity building of farmers and agricultural extension workers. IER collaborates closely with other international research institutions. An example of a collaborative research project is the CGIAR Research Programme on Climate Change, Agriculture and Food Security's Climate-Smart Village programme which is being implemented in the Segou Region of Mali. In these climate-smart villages, farmers work with researchers and other local partners to test a portfolio of climate-smart technologies and practices in order to generate evidence on their effectiveness as well as the lessons learnt on mechanisms for their scaling
- The **National Meteorological Agency (Mali-Meteo)** provides daily and seasonal weather forecasts translated in local languages and disseminated through national and private radios.

External actors: External actors have been actively supporting the government and farmers directly in the promotion and scale out of CSA related activities at various levels.

- **FAO** , together with national and international partners, has been promoting integrated pest management for improved yields through the Integrated Production and Pest Management Programme (IPPMP), with projects that focus on rice and cotton production, reduced use of agro-chemicals, improved farmers' resilience through capacity building (farmers field schools) and livelihoods
- A partnership between **USAID, the German Development Bank** (KfW), the **European Union**, the **Canadian Government** and **Malian institutions** is assisting the implementation of the National Program for Small-Scale Irrigation 2012-2021 through small-scale irrigation projects in the Sikasso region in the South. The initiative involves the installation of micro dams to trap rainfall water in small ponds and supplement water needs for agriculture, livestock and fisheries in times of scarcity
- The **African Development Fund (ADF)** also supports irrigation infrastructure work in the country, particularly the rehabilitation of existing irrigated land and development of value chains for growth-oriented crop sectors (capacity building and technical innovations)

Climate change is also formally mainstreamed into **national planning and programming**, and aligned to the Strategic Framework for Growth and Poverty Reduction (SFGPR). These include:

- **National Policy for the Protection of the Environment** which focuses on desertification, sustainable natural resource management and food security;
- **National Agricultural Policy**; **the National Policy for Land Use Planning; the National Water Policy**, which pursue one key objective on the use of water for agricultural adaptation and productivity

Others include Mali National Agricultural Investment Plan; the National Food Security Plan; and National Strategy for the Prevention and Management of Disaster Risk (SNPGRC, French acronym)

Climate-Smart Agriculture Investment Plan (CSAIP): The country, with support from the World Bank, has developed a Climate-Smart Agriculture Investment Plan (CSAIP), in line with the Agriculture Adaptation in Africa initiative (AAA). The CSAIP identifies specific interventions that define on-the-ground action that are consistent with Mali's NDC and national agricultural strategy, which can be funded by public and private sector partners. CSA interventions are designed to increase agricultural productivity, to help farmers, livestock keepers and fisher people adapt and build resilience to climate risks, and, where appropriate, to reduce greenhouse gas emissions that cause climate change. This plan includes a set of 12 key CSA investments for Mali that were developed with strong stakeholder engagement, expert input and scientific evidence.

Financing CSA

CSA activities are mainly funded by the Global Environment Facility and Mali Climate Fund. A major funder of climate-smart agriculture related work in Mali is the Global Environment Facility (GEF), for which the country has accessed funds for projects related to improved hydro meteorological information and integration of climate change adaptation into the agricultural sector

Bilateral donors such as the United States Agency for International Development (USAID), have also contributed to various food security and resilience related projects.

Climate finance is channelled through the **Mali Climate Fund (MCF),** a mechanism set up in 2012 to mobilize and anchor bilateral, multilateral, public and private financing. Till 2015, the MCF successfully

mobilized USD 7.29 million from the Governments of Norway and Sweden, targeted towards agriculture, livestock and fisheries and water management.

Outlook

Mali is making significant progress in creating an enabling policy environment for agricultural development as well as the integration of climate change adaptation and mitigation into agricultural plans and policies. The CSAIP with its 12 investment project ideas is a key tool that can support the deployment of concrete projects in the ground. The Mali Climate Fund also presents a huge opportunity for aggregating climate finance from various sources and directing it to agricultural practices deemed to be most climate-smart. However, private sector engagement in climate finance for agriculture needs to be enhanced and a detailed CSA private sector engagement strategy could be beneficial for the country. [15]

[15]Climate-Smart Agriculture in Mali, 2021

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