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Climate-Smart Agriculture (CSA): A Need of Hour

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Why do we Need Climate-Smart Agriculture?

The UN Food and Agriculture Organisation (FAO) estimates that feeding the world population will require a 60 percent increase in total agricultural production. With many of the resources needed for sustainable food security already stretched, the food security challenges are huge. At the same time climate change is already negatively impacting agricultural production globally and locally. Climate risks to cropping, livestock and fisheries are expected to increase in coming decades, particularly in low-income countries where adaptive capacity is weaker. Impacts on agriculture threaten both food security and agriculture's pivotal role in rural livelihoods and broad-based development. Also the agricultural sector, if emissions from land use change are also included, generates about one-quarter of global greenhouse gas emissions.

What Defines Climate-Smart Agriculture?

Climate-smart agriculture (CSA) is an integrative approach to address these interlinked challenges of food security and climate change, that explicitly aims for three objectives:

1. Sustainably increasing agricultural productivity, to support equitable increases in farm incomes, food security and development;
2. Adapting and building resilience of agricultural and food security systems to climate change at multiple levels; and
3. Reducing greenhouse gas emissions from agriculture (including crops, livestock and fisheries).

What is The History of Climate-Smart Agriculture?

FAO coined the term CSA in the background document prepared for the 2010 Hague Conference on Food Security, Agriculture and Climate Change. The CSA concept was developed with a strong focus on food security, for now and the future, including adaptation to climate change. The CSA concept now has wide ownership among, governments, regional and international agencies, civil society and private sector. Emerging global and regional (Africa) Alliances on Climate-Smart Agriculture (ACSA) provide a platform for shared learning and collaboration among all interested parties.

What is Different about Climate-Smart Agriculture?

In the twentieth century, significant increases in agricultural productivity were achieved under the banner of the so-called 'Green Revolution'. Through monocropping and an increased use of pesticides and fertilizers, crop yields around the world steadily rose.

Climate-smart agriculture (CSA) is not yet another reincarnation of the 'Green Revolution'. To the contrary, CSA has much in common with sustainable agricultural approaches. This means that addressing climate change does not require us to discard or reinvent everything that has been learned about agriculture and sustainable development in recent decades. In fact, CSA is built upon a technical foundation that largely already exists and a range of sustainable agricultural approaches - such as sustainable agriculture, sustainable intensification and conservation agriculture - are the cornerstones of implementing CSA in practice.

So how does CSA differ from sustainable agriculture? This boils down to three essential features: (i) an explicit focus on climate change; (ii) the search for synergies and negotiation of trade-offs in the pursuit of productivity, adaptation and mitigation outcomes in a broader landscape or system perspective; and (iii) the availability of new funding opportunities for agricultural development.

The three big differences

i) A focus on climate change: Like other sustainable agricultural approaches, CSA is based on principles of increased productivity and sustainability. But it is distinguished by a focus on climate change, explicitly addressing adaptation and mitigation challenges while working towards food security for all. In essence, CSA is sustainable agriculture that incorporates resilience concerns while at the same time seeking to reduce greenhouse gas emissions.

CSA = Sustainable Agriculture + Resilience – Emissions.

ii) Outcomes, synergies and trade-offs: To develop interventions that simultaneously meet the three challenges of productivity, adaptation and mitigation, CSA must not only focus on technologies and practices, but also on the outcomes of interventions beyond the farm level. In doing so, it must consider the synergies and trade-offs that exist between productivity, adaptation and mitigation, as well as the interactions that occur at different levels including wider socio-ecological implications. For instance, CSA interventions at the farm/community level may affect both the social and ecological systems in place, as well as the wider landscape. Likewise, a CSA intervention that aims to increase productivity should also consider how it affects adaptation and mitigation, and how it can best optimize all three outcomes at the most appropriate level. All of this requires farmers and decision-makers to understand the synergies and trade-offs that exist between the three pillars and between different levels. To help people make informed decisions - from the farm to parliament - CSA focuses on developing metrics and prioritization tools that bring these synergies and trade-offs to the fore.

iii) New funding opportunities: Currently, there is an enormous deficit in the investment that is required to meet food security. By explicitly focusing on climate change, CSA opens up new funding opportunities for agricultural development, by allowing the sector to tap into climate finance for adaptation and mitigation. This includes funding from, among others, the Adaptation Fund, the Least Developed Countries Fund or the Special Climate Fund, as well as the Clean Development Mechanism and the Voluntary Carbon Market. Most promising of all is the earmarked allocation which has been made specifically for CSA by the Global Environment Facility Trust Fund (GEF) and the future Green Climate Fund.

What are the Main Elements of Climate-Smart Agriculture?

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 which can be integrated in climate-smart agricultural approaches include:

1. Management of farms, crops, livestock, aquaculture and capture fisheries to manage resources better, produce more with less while increasing resilience
2. Ecosystem and landscape management to conserve ecosystem services that are key to increase at the same time resource efficiency and resilience
3. Services for farmers and land managers to enable them to implement the necessary changes

What Actions are needed to Implement Climate-Smart Agriculture?

Governments and partners seeking to facilitate the implementation of CSA can undertake a range of actions to provide the foundation for effective CSA across agricultural systems, landscapes and food systems. CSA approaches include four major types of actions:

1. Expanding the evidence base and assessment tools to identify agricultural growth strategies for food security that integrate necessary adaptation and potential mitigation
2. Building policy frameworks and consensus to support implementation at scale
3. Strengthening national and local institutions to enable farmer management of climate risks and adoption of context-suitable agricultural practices, technologies and systems
4. Enhancing financing options to support implementation, linking climate and agricultural finance

Practices under Climate-Smart Agriculture

Integrated practices

Holistic, integrated practices in which a range of stakeholders are involved ensure greater efficiency in the use of resources and more sustainable management of natural and human-created processes in the landscape. Integration can greatly reduce the pressure on the natural resources and minimize the need for external inputs (e.g. energy, chemical fertilizers and pesticides).

Crop production

To cope with the challenges of climate change, crop production must adapt (e.g. crop varietal selection, plant breeding, cropping patterns and ecosystem management approaches) and become resilient to changes (frequency and intensity). Crop production can contribute to mitigating climate change, for example by reducing the use of inorganic fertilizers, avoiding soil compaction or flooding to reduce methane emissions (e.g. in paddy rice systems) and sequestering carbon (e.g. planting perennial crops and grass species).

Livestock

Livestock can make a large contribution to climate-smart food supply systems. Options to reduce greenhouse gasses are available along the entire supply chain and are related to feed management, enteric fermentation and manure management. Livestock's role in climate-smart practices relates primarily to the management of organic matter and nutrients. Several CSA practices have already been implemented. These practices include pasture management, zero-grazing, grassland restoration and management (e.g. sylvopastoral systems), manure management (e.g. recycling and biodigestion) and crop-livestock integration.

Forestry

Climate change jeopardizes the delivery of goods and ecosystem services, from forests and trees that are essential to livelihoods and food security, to environmental sustainability and to national development. Climate-smart forestry requires more widespread application of sustainable forest management (SFM) principles that provide a fundamental foundation for climate change mitigation and adaptation. Mainstreaming climate change into forest policy and practice enables the finding of synergies and the management of trade-offs with other forest management objectives.

Urban and peri-urban agriculture

The rapid growth of cities in the developing world is placing huge demands on urban food supply systems. Agriculture – including horticulture, livestock, fisheries, forestry, and fodder and milk production – is increasingly spreading to towns and cities. Urban and peri-urban agriculture (UPA) provides fresh food, generates employment, recycles urban waste, creates greenbelts, and strengthens cities' resilience to climate change. Practices include Hydroponics and Trees outside the Forest (TOF).

Genetic resources and biodiversity

Agriculture, including livestock, forestry, aquaculture and fisheries, depends on the three components of biodiversity: the diversity of species, the diversity within each species and the diversity of ecosystems. Genetic resources for food and agriculture play a crucial role in food security, nutrition and livelihoods and in the provision of environmental services. They are key components of sustainability, resilience and adaptability in production systems. They underpin the ability of crops, livestock, aquatic organisms and forest trees to withstand a range of harsh conditions. The first Global Conference on Agriculture, Food Security and Climate Change, held in The Hague in 2010, identified a Roadmap for Action, which includes genetic resources among the tools and technologies for climate-smart agriculture.

Fisheries and aquaculture

Fisheries and aquaculture provide essential nutrition, support livelihoods and contribute to national development. However, the sector is facing significant challenges in maintaining its crucial contribution to these areas. Increasing global demand for fish and aquatic foods, ocean acidification and climate variability and change only adds to these challenges.

Climate-smart fisheries and aquaculture require**:**

- Improved efficiency in the use of natural resources to produce fish and aquatic foods
- Maintenance of the resilience of aquatic systems and the communities that rely on them to allow the sector to continue contributing to sustainable development
- Effective ways to reduce the vulnerability of those most likely to be negatively impacted by climate change.

Land and water management

Land and water management is a key element of CSA. More productive and more resilient agriculture requires a major shift in the way land and water are managed to ensure that these resources are used more efficiently. Sustainable Land and Water Management (SLM) includes a broad range of practices and methods including the restoration of peatlands and degraded lands. SLM also increases the amount of carbon sequestered in the soil, enhancing the soils nutrients and its water retention capacity. Other issues to be considered include cultural, environmental and political factors such as land rights. Secure land rights provide the enabling environment for the investment in sustainable land management including the restoration of peatlands and degraded lands and the management of Grasslands, Rangelands and Forage Crops and water and irrigation management - a key element of CSA.

Proactive drought management

Drought is a complex natural hazard which affects all climates and results in socio-economic impacts, the extent of which varies depending on several factors and conditions. Agriculture is the first and most drought affected sector. The drought policy approach is a methodology, a structure and a process for drought preparedness with the following inherent characteristics:

- Integration, through joint planning by the concerned sectors
- Decentralization as well as participatory planning and implementation
- Synergy between the long-term development and the short-term emergency response to drought
- Prioritization of mitigation and response measures

- Timed, location-specific short and medium-term actions and measures, before during and after drought
- Adaptation to climate change through resilience building
- Sustainability of natural resources and environmental protection
- Building on what exists using relevant tools and practices already in place for the different sub-sectors (crops, land, water, animal production, fisheries, forestry, etc.)

Energy

Agricultural producers can use energy more efficiently as well as reduce their dependency on non-renewable energy sources. Well-planned agricultural systems can also produce energy sustainably without compromising food security thus contributing to the transition to climate-smart agriculture. This can only happen if existing examples of energy-smart food systems can be scaled up significantly. A safe integration of food and energy production may be one of the best ways to improve national food and energy security through Integrated Food Energy Systems (IFES). Integrated energy production can reduce poverty in a climate smart way.

Synergies between energy-smart and climate-smart agricultural practices can be created through resource-efficient farming practices that reduce pressures on land use change. Such practices also reduce greenhouse gas emissions from agriculture and lessen the reliance on fossil fuels enhancing the productivity and resilience of agro-ecosystems.

Food loss and waste

Food loss and waste amounts to major loss of resources, including water, land, energy, labour and capital and leads to greenhouse gas emissions, contributing to climate change. Projects such as FAO's Food Waste Footprint (FWF) project and Save Food: Global Initiative on Food Loss and Waste Reduction, demonstrate that reducing food wastage is a logical priority to establish more sustainable patterns of production and consumption. Investments in food wastage reduction can achieve economic, environmental and social dividends, while contributing to food security and reducing greenhouse gas emissions.

Nuclear techniques

FAO, through its Joint FAO/IAEA (International Atomic Energy Agency) Division and its dedicated Agriculture & Biotechnology Laboratories, uses isotopic and nuclear techniques to support climate-smart agriculture. This includes the application of nuclear and related techniques to:

- sustainably increase agricultural productivity,
- adapt and build the resilience of agricultural and food security systems to climate change
- reduce greenhouse gas emissions in agriculture, taking into account national and local contexts and priorities.

Case Studies related to Climate-Smart Agriculture (Projects from Around the World)

The case studies discuss context-specific activities that contribute to CSA's three pillars: sustainably increasing agricultural productivity and incomes, adapting and building resilience of people and agri-food systems to climate change, and reducing and/or removing greenhouse gas emissions where possible. Many of the case studies under following action plan pay special attention to smallholder farmers, including women and indigenous groups, who are particularly affected by the impacts of climate change.

ACTION POINT 1 – EXPANDING THE EVIDENCE BASE

•**Mali** – complementing agricultural policies through the Climate-Smart Agriculture Investment Plan

•**Sri Lanka** – working together to scale up climate-smart crop systems

•**Senegal** – enhancing CSA learning by understanding indigenous knowledge and perceptions of climate change
• **Somalia** – mapping climate-smart agricultural practices of rural women
• **Africa and the Near East** – using remote sensing to monitor water productivity

ACTION POINT 2 - SUPPORTING ENABLING POLICY FRAMEWORKS
• **Italy** – working with stakeholders in European Innovation Partnership Operational Groups to create climate-smart innovations in Emilia-Romagna
•**Moldova** – promoting conservation agriculture through policy engagement and capacity building for smallholder farmers
• **African Region** – helping implement and coordinate policies with CSA country profiles

ACTION POINT 3 – STRENGTHENING NATIONAL AND LOCAL INSTITUTIONS
• **Cambodia and Mongolia** – strengthening capacities in the agriculture, forestry and other land use sectors to improve the monitoring of and reporting on progress towards NDCs
• **Ghana** – developing training capacity for climate-smart agriculture in cocoa
• **Botswana** – integrating traditional practices for CSA into crop and livestock production systems

ACTION POINT 4 – ENHANCING FUNDING AND FINANCING OPTIONS
• **Global** – the Sustainable Rice Landscape Initiative: attracting funding and financing to scale up sustainable rice production
• **Switzerland** – piloting a goal-oriented farmer payment system for climate-smart milk production
• **Egypt** – implementing the Sustainable Agriculture Investments and Livelihoods project

ACTION POINT 5 – IMPLEMENTING PRACTICES AT FIELD LEVEL
•**Lao People's Democratic Republic** – addressing labour scarcity through the gender-sensitive roll-out of drum seeders for rice.
•**Kyrgyzstan** – sustainably managing mountainous forest and land resources under climate change conditions
•**Ecuador** – promoting climate-smart livestock management and cocoa production 70
•**Georgia** – enhancing agricultural resilience to climate change by developing inclusive climate-smart value chains
•**Saint Lucia** – advancing the use of information and communication technology solutions for climate-smart agricultural practices.

Climate-Smart Agriculture in Indian Scenario

Disease-resistant and early maturing chickpeas boost production in Andhra Pradesh, India: Avoiding terminal drought and heat stress by growing shorter-term chickpea varieties provides a substantial contribution to short-term adaptation through climate risk management and avoidance. In addition, the resistance to Fusarium Wilt provides additional adaptation gains. Fusarium wilt infection is favoured by high temperatures and warm moist soils, conditions which climate change projections suggest are likely to become more prevalent in Southeast Asia.

Climate information services: In Haryana, India, women farmers tend to be left out when it comes to accessing climate information and agro-advisory services because of institutionalized socio-cultural barriers, low literacy levels, hectic daily schedules, and a lack of agency in decision-making. The project has taken measures to ensure that it is inclusive to women farmers in Haryana, as they typically rely on male household members to get information. At first, including women farmers in the project was met with resistance, but through focus group discussions and by involving local women leaders, women finally signed up. During some of the frank discussions, some people questioned why women needed to receive information if they are not taking any important decisions. However, female farmers provided feedback that indicated they appreciated the awareness the initiative has created on climate-smart agriculture practices and the issue of climate change.

India's Integrated Agro-meteorological Advisory Service (AAS): The program provides meteorological (weather forecasting), agricultural (identifying how weather forecasts affect farming), extension (two-way communication with users) and information dissemination (media, IT and others) services. Tailoring information to farmer needs at a district scale is accomplished through multi-institutional teams, or "Agro-Meteorological Field Units" in each of the 127 agro-climatic zones. Maini and Rathore (2011) noted that AAS had contributed to both greater productivity and increased resilience by encouraging farmers to adopt modern agricultural production technologies and practices, weather-based irrigation management, pest/disease management, and the use of improved post-harvest technologies.

National agroforestry policy of India: Of the 118 million farmers in India, over 80% are rainfed smallholders, who cultivate on two hectares of land or less. The dependence on seasonal rainfall as well as the small size of landholdings makes them highly vulnerable to climate change impacts. Agroforestry (incorporating trees and shrubs into farmlands and rural landscape) is a useful strategy for such farmers to increase the productivity from their land as well as to increase the resilience to climate change impacts. Taking cognizance of the multiple benefits of agroforestry, the Government of India launched an ambitious National Agroforestry Policy in 2014, to mainstream tree growing on farms. The policy aims to create convergence between various programs, schemes and agencies containing agroforestry elements, in order to enhance the productivity, income and livelihoods of smallholder farmers. The policy also helps meet the increasing demand for agroforestry products such as timber, food, fuel, etc., protecting the environment and natural forests, and minimizing the risk during extreme climatic events. Since the policy was adopted in 2014, grants have been provided to six states and will cover approximately 70,000 ha in agroforestry.

Solar Power as a 'Remunerative Crop' (SPaRC): In India, solar energy constitutes just 1% of the energy mix, but the Government aims to increase this to around 10% by 2020 by adding 100,000 megawatts of solar energy generation capacity. SPaRC was established by the International Water Management Institute (IWMI) and is being scaled up with support from the CGIAR Research Program on Climate Change, Agriculture and Food Security (CCAFS). SPaRC offers farmers a guaranteed buy-back of the surplus solar power they produce, provided they are connected to the electricity grid. This guarantee allows farmers to invest in solar powered pumps, which reduce the use of carbon intensive diesel pumps on farms. Solar energy reduces the amount of GHG emissions and overall dependence on fossil fuels. It is estimated that through the use of solar power in India´s groundwater economy, annual carbon dioxide emissions can be reduced by nearly 6%. Using solar energy as a remunerative crop augments the incomes of farmers, improving resilience and livelihoods.

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