Climate Smart Agriculture (CSA) – A Boost to Tackle Disaster

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ABSTRACT

In the face of increasing climate change causing rising temperature, changing rainfall pattern, increased frequency of extreme weather events such as cyclones and floods it is challenging for farmers to have a stable production and income. To tackle these natural disaster Climate Smart Agriculture (CSA) came into force to address the challenges of climate change. It is a triple - win outcome aims to increase productivity and income in a sustainable manner, adapting to and strengthening resilience to climate change and reducing or eliminating greenhouse gas emissions. The importance of CSA is to increase the productivity without harming the ecosystem by following various practices which promote efficient utilization of resources and better risk management strategies. This article highlights the government support globally and nationally by forming committees, providing insurance schemes and policies that promote CSA. There are some challenges limiting the adoption of CSA. But the future of agriculture largely depends on the CSA to make resilient agriculture no longer an option but essential to reduce the effect of natural disasters.

INTRODUCTION

Agriculture is the backbone of our nation food security and economic development. With the increase in global warming it is very important to address the adverse impact of climate change. Farmers today face unpredictable rainfall, rising

temperatures and frequent natural disasters all this threaten crop production and their livelihood. In such a situation there is a need to identify desirable practices and access to right information at the right time is very important for rising above the current challenging climatic situation. Climate Smart Agriculture is the only option to tackle the disaster. It is an approach to transforms agricultural systems by sustainably increase productivity, enhancing resilience and reducing greenhouse gas emission and aims to achieve national food security and development goals. Climate Smart Agriculture is not just an approach it's a way of living and surviving in the increasing global population and pollution, we have to be smart enough in our practices and decision making to tackle the natural disasters that is unpredictable and unavoidable .It is an approach that integrates traditional indigenous practices with modern science based technologies that are knowledge intensive , location specific and require considerable capacity development . While CSA is recognized as a vital strategy for boosting productivity and enhancing resilience to climate change its adoption remain low, especially among small scale producers. By adopting climate smart agriculture practices, farmers can be prepared for disasters, reduce losses and ensure food security. This article tells about the practices, challenges and future aspects of Climate smart agriculture in tackling disasters and building a more resilient agricultural system.

Three Pillars of Climate Smart Agriculture

Productivity: It aims in sustainably increasing agricultural productivity and farmers incomes while enhancing ability to deal with climate change. It is to serve the increasing demand for food under climate change without harming the ecosystem. Innovation which leads to high yield, enhance resource efficiency and resistant to climatic stresses are good characteristic of a Climate Smart Agriculture. n current time we are more technology driven which help in farming and protecting against extreme climate. Implementing of precision farming technique including GPS, GIS, Remote Sensing, Drones , Sensor , Variable Rate Application helps in resource use efficiency and increasing productivity. It ensures that enough food is produced to meet the growing population without degrading the ecosystem.

Adaptation: It is the strategies that help farmers adjust to climate variability while raising productivity to build climate resilience in farming systems. The strategies that can be followed are crop diversification which reduce risk and improves resilience against climate change, agroforestry practices by integrating trees with crop and livestock enhance soil fertility, water management practices help in coping with irregular rainfall to conserve water and many more practices are there which helps in adoption of techniques to go towards the target of achieving resilience towards climate change.

Mitigation: It is the practices that reduce GHG emission. The major GHG are CO_2,CH_4 and N_2O that trap heat radiating from Earth creating a warming greenhouse effect . These emission from agriculture must be reduce by combination of various field level strategies. An efficient nutrient management will help in reducing N_2O, practicing alternate wetting and drying in rice fields instead of directly flooding will minimize methane emission significantly, minimum or zero tillage to reduce soil disturbance and use of cover crops helps in reducing CO_2 emissions. These

strategies not only mitigate emission but also improves farmers productivity and income.

Climate Smart Agriculture in disaster risk reduction

There are many advantages of CSA to tackle the challenges of climate change. Major agricultural disasters faced by farmers are drought, floods, cyclones, erratic rainfall and soil degradation. By implementing CSA can help in tackling disaster by improving agricultural practices with sustainability.

Increase in productivity: CSA practices use improved crop varieties, precision farming technique and better soil management practices which leads to high crop yields, enhancing farmers decision making skills and protecting themselves from climate change by having high productivity and income

Efficient use of resources : Utilization of resources efficiently is very important in farming. Practicing climate smart agriculture helps farmers in identifying the best resources for higher productivity, climate resilience and reduced environmental impact

Improves soil and water management : CSA promotes optimal use of water and soil through techniques like rainwater harvesting , drip irrigation ,crop rotation , organic amendments and integrated nutrient management helps in maintaining productivity under stressed conditions.

Better risk management: Practicing CSA helps farmers to be aware of the climate change and to have time to time climate information and availing climate services like insurance schemes helps farmers in making informed decision and reduce losses.

Enhance livelihood security: CSA enhance the ability of farmers to maintain a stable income by practicing diversification in farming, drought tolerant seeds, improved varieties, soil and water conservation and integrated farming system will help farmers in sustaining their resources and building a resilient farming system which ensure long term stability for rural livelihoods.

Sustainable Development: Sustainable development in agriculture is balancing present needs without compromising future generations. It enhances the long-term environmental protection, productivity, income stability and social well-being. Agricultural policies that boost productivity without harming ecosystems can achieve SDG 2 (Zero Hunger) and SDG 13 (Climate Action).

Government Policies and Support towards the development of CSA

Government Policies and Institutional Support plays a key role for implementation of CSA. There are International and national policies that works towards achieving resilient , sustainable and productive farming systems in the face of climate change .

Food and Agriculture Organization (FAO): It is the organization that introduced and popularized the CSA concept worldwide .FAO formally introduced the concept of Climate Smart Agriculture in 2010 . It defines the three pillars of CSA, helps government design CSA based agricultural policies and strategies, collaborates with global research bodies like CGIAR .It provides global leadership and direction for CSA policies

The Paris Agreement : It is a legally binding international treaty on climate adopted by nearly all countries of the world to combat global warming and its impacts. The Agreement replace the top-down, legally mandate approach to climate governance with a hybrid model that incorporates national action into a global cycle of transparency and stock-take (Chaudhary *et al*., 2025). Adopted in 2015 and entered into force in 2016 signed

under the United Nations Framework convention on climate change (UNFCCC)

Global Alliance for Climate Smart Agriculture (GACSA) : It is a voluntary , multi-stakeholder platform (governments , NGOs , Private sectors) launched in 2014 to promotes knowledge sharing and voluntary action . It fasten the transformative partnership to encourage climate smart agriculture (CSA) practices, connecting farming with climate change goals like SDGs

World Bank : It is the major financier of Climate Smart Agriculture (CSA) . The world bank is intended to offer a planning framework for determining the most cost effective investments for increasing agricultural production in the face of climate change (Balo and Mahata, 2022)

Implications of government policies for achieving climate smart agriculture in India

National Mission for Sustainable Agriculture (NMSA) : It is one of the missions under National Action Plan on Climate Change (NAPCC) .Its key component is Rainfed Area Development (RAD) and Soil Health Management (SHM)

National Innovations in Climate Resilient Agriculture (NICRA) : It is a flagship network project launched by the Indian council of Agricultural Research (ICAR) in 2011. It operates in vulnerable districts to address climate related risk such as droughts, Floods and cyclones . Particularly targeting small and marginal farmers in rainfed , coastal and hill regions.

Pradhan Mantri Fasal Bima Yojana (PMFBY) : It is launched in 2016 to provide financial assistance, stable income and risk coverage to farmers in the events of crop failure due to natural calamities, pest or diseases. It provides crop insurance at very low premiums (2% for Kharif and 1.5% for Rabi)

Pradhan Mantri Krishi Sinchaye Yojana (PMKSY) : It is launched in 2015 PMKSY is different from earlier schemes as it emphasizes on increasing the irrigated area ("Har Khet Ko Paani" or water to every plot of land), recharging aquifers, increasing water-use efficiency ("More Crop Per Drop") and promoting sustainable water conservation practices(Kishore *et al*.,2018) it encourage farmers to adopt modern technology for effective use of water .

Challenges in adopting Climate Smart Agriculture

Despite of having high potential in tackling climate change its adoption is still low due to various challenges primarily high initial investment , lack of awareness , limited access to resources and poor extension services .One of the recurring challenges in the implementation of CSA is the inadequacy of coherent policy frameworks and institutional coordination. In many developing countries ,CSA is still treated as a sectoral intervention rather than an integrated approach that links agriculture , climate change adaptation ,and sustainable development (Naveen ,2025). Lack of technical knowledge or training and limited access to water also indicate that both knowledge and resource limitations affect adoption . Other challenges included poor market linkages ,lack of government or NGO support , climate shocks , limited land availability and labor shortages (Nur *et al*., 2026).Therefore an effective integrated approach is required that strengthen farmers knowledge ,financial support, strong policies and improved market environment .

Future Prospects to tackle Disaster by Climate Smart Agriculture

The future of agriculture is at turning point. Growth and development is necessary to cope

with rising declining soil fertility , food demand , land and water usage conflicts as well as the effects of global change ,including climate change (Balo and Mahata,2022) . The practical pathway for the future prospects of CSA should focus on sustainable food security, Climate Resilience and adaptation, reduction in green house gas emissions , integration of digital agriculture, growth of precision farming system ,increase investment and policy support , strengthening farmer institutions , diversification and integrated farming systems , better market opportunities , capacity building and awareness. Therefore the future of farming in a disaster prone world lies in widespread adoption of CSA which can transform vulnerable agriculture into adaptive, productive and sustainable agriculture.

Major future prospect are :

- CSA will become the backbone of disaster resilient farming
- Expansion of digital weather intelligence and early warning systems
- Greater development of climate resilient crop varieties
- Water smart agriculture will dominate future farming
- Diversified farming systems will replace monocropping
- Strong government and institutional support will increase
- CSA will improve food security under frequent disasters
- Carbon sequestration and ecosystem restoration will add long-term protection
- Community based CSA models will grow in villages
- CSA will become unavoidable, not optional

CONCLUSION

This article highlights the importance of CSA to tackle the natural disaster by embracing CSA as a cost effective and timely solution to climate change. It is very crucial for achieving food security and sustainable agriculture. It offers a viable pathway to climate adaptation with measurable economic returns. There are many practices which are very important in dealing with climate change. All these practices focus on achieving productivity without degrading the environment. These practices involve indigenous knowledge along with modern science technologies. Climate change is a global problem, there are many government policies and framework which support climate smart agriculture globally. India also has their own policies and schemes to provide insurance and safety against climate change. It provides support to the farmers from any natural disaster that effect their crop production, income and livelihood. However, the study also reveals that even though CSA have a huge impact in overcoming climate change its adoption level is low due to various challenges especially due to lack of awareness and knowledge. Overall CSA is the most appropriate approach for the present situation. It is a transformative pathway towards sustainable agriculture ensuring both present and future generations are having enough food supply and a healthier ecosystem.

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