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Climate Smart Agronomical Practices for Increasing Agricultural Production

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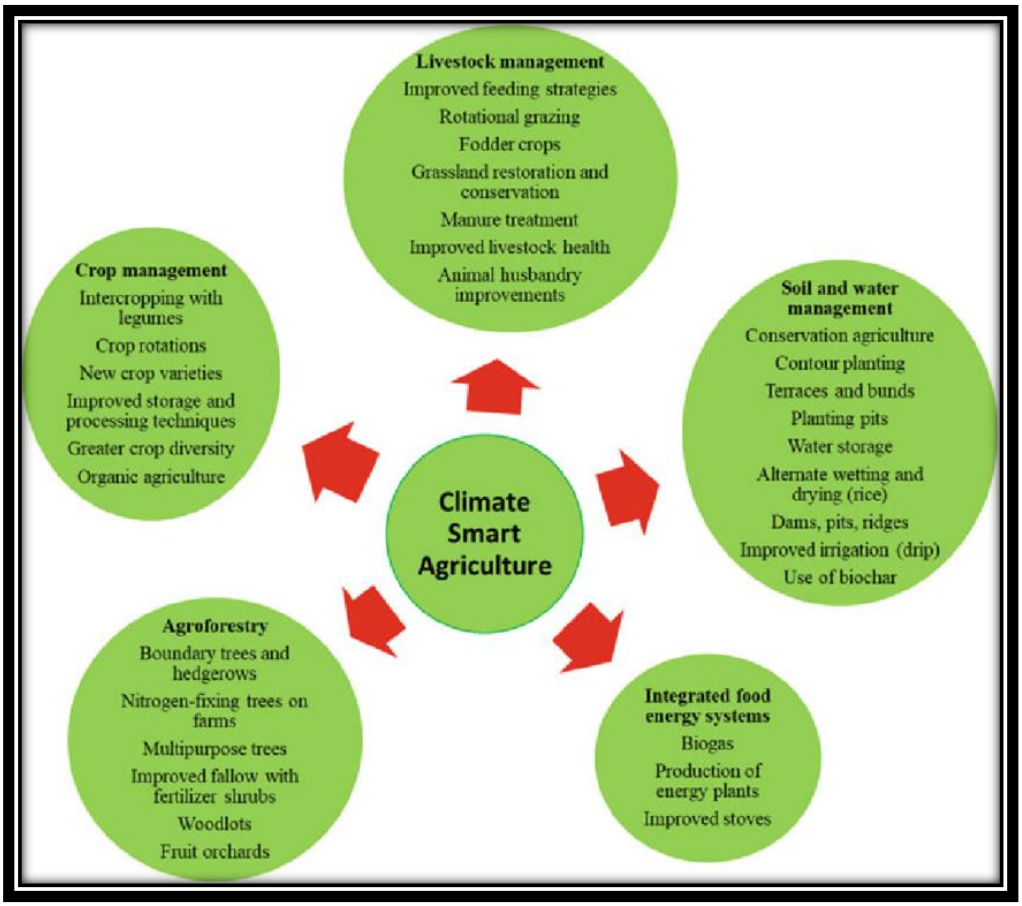
INTRODUCTION

The global population is steadily growing, but agriculture is being jeopardized by the deterioration of natural resources and the effects of climate change. The shifting climate has a detrimental impact on production stability, agricultural output, revenue, and food security. Hence, agriculture must adapt to the present situation in order to fulfil the requirements of food security and overcome the challenges posed by climate change. Forecasts based on food consumption patterns and population growth indicate that agricultural production will need to be increased by 65% in order to meet the demands of the growing population by 2050. Agriculture is both a significant emitter and absorber of greenhouse gases (GHGs). Therefore, it is imperative to adapt agricultural techniques in a manner that is more environmentally friendly and can effectively address these challenges. Therefore, it is essential to prioritise the development of agriculture that is capable of withstanding the impacts of climate change in order to successfully attain both future food security and climate change objectives. Adaptation and mitigation measures aid the agricultural system in building resistance against damage and facilitating swift recovery. Mitigation techniques aim to decrease the greenhouse gas emissions generated by the agricultural system, while adaptation strategies aim to ensure continued agricultural production in the face of changing circumstances.

Importance of Climate Smart Agriculture

Climate change contributes to degradation processes in already-degraded environments and has an adverse impact on food production. The potential reduction in main crop yields across India, caused by the impacts of climate change, is projected to reach up to nine percent between 2010 and 2039.

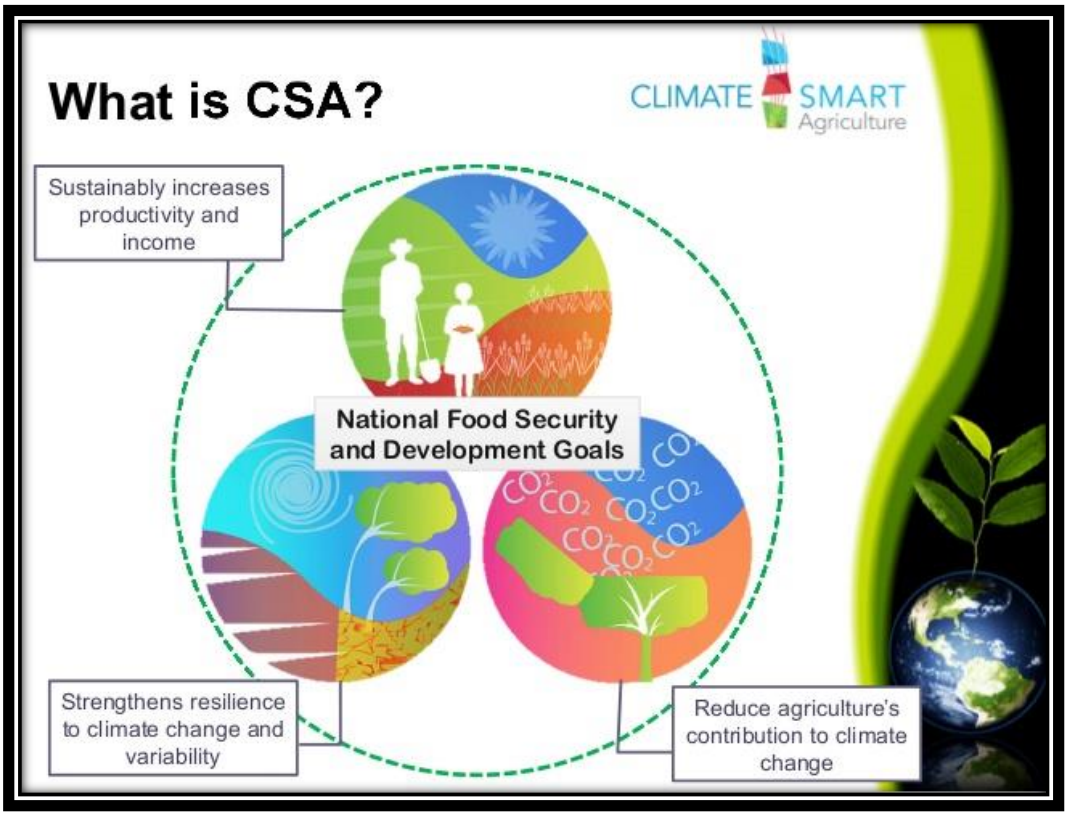
The necessity to adopt Climate Smart Agriculture (CSA) has been intensified due to unpredictable climate conditions, in order to mitigate the adverse effects of climate change on agricultural systems. An immediate and essential requirement is to revolutionize the agricultural industry, encompassing the cultivation of crops and animals, fisheries, and forests. This transformation is necessary to effectively address the challenges posed by climate change and to achieve sustainable growth in agricultural output and incomes. Climate-smart agriculture is based on the principles of sustainable agriculture and rural development. If these principles are achieved, it would help in accomplishing the Millennium Development Goals (MDGs) of reducing hunger and enhancing environmental management.



What is Climate Smart Agriculture

Climate Smart Agriculture refers to a set of practices and approaches that aim to increase agricultural productivity, enhance resilience to climate change, and reduce greenhouse gas emissions. It involves the use of sustainable and innovative techniques that promote sustainable land management, water conservation, and the use of climate-resilient crop varieties.

The term "climate-smart agriculture" (CSA) refers to a variety of agricultural strategies that aim to adapt and enhance agricultural systems in order to ensure food security in the context of climate change. A CSA strategy aims to include climate change considerations into the planning and execution of sustainable farming practices. Additionally, its objective is to enhance the ability of agriculture to withstand climate fluctuations by implementing more effective measures to adapt to climate change, while simultaneously decreasing agriculture's impact on global warming.



Climate-resilient crop production

Each crop system has numerous climate change adaptation and mitigation methods available that can effectively enhance yields and reduce the adverse environmental effects of production in a sustainable manner. The variations will be unique to each agricultural household, based on their individual coping and adapting strategies. Management strategies and technologies for addressing climate change involve specific practices that directly target adaptation, as well as broader practices that aim to minimise production risks and reduce emissions. Some precise climate-smart approaches to agricultural production include:

To enhance diversity and complexity in the agricultural ecosystem, various approaches can be employed. These include expanding the range of crops or crop varieties, implementing strategies at different spatial scales (such as landscape level, within farms, or within specific crops), and considering different timeframes. Another important aspect is the improvement of sustainable soil and land management. This involves carefully planning the expansion of crop and grazing land to minimize the loss of carbon.

Developing climate-ready crops

The key to maintaining yield stability is in the development of new crop types that possess better yield potential and are resistant to diverse stresses, both biotic and abiotic. A number of drought-resistant cultivars have been introduced in South and Southeast Asia. For Example, in 2010, the Sahbhagi Dhan variety, which was introduced and officially recognised in India, demonstrated a consistently strong performance in both transplanted low-land conditions and rain-fed direct-seeded highland areas. It shows an 108% increase in crop yields when using Sahbhagi Dhan compared to commonly grown local cultivars in a water-scarce scenario. Sahbhagi Dhan achieved a yield of 4.7 t ha−1 with just one to two irrigation sessions. Similarly, Sahbhagi dhan, namely IR64-Drought1, is an additional variety of rice that

is adapted to withstand climate conditions. Under climate change scenarios, nitrogen utilization efficiency may decrease due to increased leaching and volatilization losses caused by heavy precipitation and high temperature, respectively. However, concurrently, heightened levels of carbon dioxide (CO2) prompt the growth and progression of plants, consequently resulting in a heightened need for nitrogen. Therefore, it is necessary to enhance the root system of plants in order to optimise nutrient and water uptake. Genetic engineering is the optimal approach for combining all the favourable characteristics in a plant to obtain the optimum plant variety for challenging climatic conditions.

The National Initiative for Climate-Resilient Agriculture (NICRA)

The ICAR initiated this programme in February 2011 with the subsequent aims:

- Enhance the ability of Indian agriculture to withstand the impacts of climate change and variations in climate through the creation and execution of plans for production and risk management.
- Implementation of site-specific technologies on a farmer's field.
- Strengthening the abilities of scientists and other relevant parties to conduct and implement research on climate-resilient agriculture.
- The smart agriculture methods promoted by ICAR in India include:
- Revitalization of agriculture in coastal agro-ecosystems susceptible to cyclones and floods through land contouring,
- Implementing staggered paddy nursery as a precautionary measure in response to drought,
- Technology for cultivating rice using direct seeding with high water efficiency,
- Drum-seeded rice for enhancing water utilisation efficiency,
- Rice cultivar with a brief growth period that exhibits resistance to drought conditions.
- Short-duration finger millet cultivars that are tolerant to drought are recommended for late season drought conditions in the south interior region of Karnataka.
- Crop kinds with a short growth cycle that are ideal for planting later in the season,
- Crop diversification is a strategy that aims to enhance livelihoods, provide food security, and promote sustainability.
- Flood-resistant cultivars provide farmers in flood-prone regions with increased resilience.
- Enhancing the ability of impoverished farmers to restore and utilise unproductive land,
- Utilising community tanks/ponds for the purpose of enhancing and controlling water resources at the village level,
- Small-scale farmers can enhance their livelihoods by implementing individual farm ponds.
- Jalkund refers to affordable structures designed for the purpose of rainwater harvesting.
- A check dam is a structure used to store surplus runoff in streams.
- Collection and reuse of rainwater via a temporary barrierThe user's text is empty.
- Increasing resilience by enhancing the efficiency of conveyance.
- Enhancing the recharge of wells to enhance the quality and quantity of shallow aquifers.
- Modules of an Integrated Farming System,
- Enhanced planting techniques to optimise water utilisation and enhance agricultural output,

- Utilise zero-till drilling technique for wheat cultivation as a means to avoid the issue of terminal heat stress.
- The utilisation of biomass and crop leftovers directly inside the soil to increase the population of microorganisms and improve soil health.
- Seed banks at the village level to mitigate seed scarcity,
- Enhanced cultivars for animal feed to address the issue of limited availability of fodder.

CONCLUSION

Climate-smart measures, such as selecting appropriate crops and cultivars, implementing integrated farming systems, employing site-specific nutrient management, practicing residue management, intercropping with legumes, and promoting conservation, are effective approaches. The implementation of agriculture-focused resource conservation technology, agro-forestry, and crop diversification can partially mitigate adverse effects and enhance the resilience of farmers by promoting sustainable growth in productivity and income. Geographically targeted medium-range weather forecasting will have a significant impact on the development of agricultural techniques, particularly during extreme climatic events such as heavy rainfall, drought, frost, hailstorms, and heat waves. Implementing water-conservation technology and water-collection structures to increase the accessibility of water during crucial phases of crop development would be a crucial measure in regions with chronic water scarcity. Crop insurance offers financial stability to small and marginal farmers in the event of significant crop damage caused by extreme weather conditions such as floods, droughts, and hailstorms. Generally, the CSA alternatives incorporate both conventional and groundbreaking techniques, technologies, and services that are applicable to specific locations. In order to achieve food security, it is necessary to implement intelligent farming methods that are both sustainable and economically and environmentally viable.

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