

Embracing climate-smart agriculture (CSA): Key opportunities and challenges

In our previous note, 'Embracing Climate-Smart Agriculture: A Sustainable Path for India's Future', we emphasised the importance of adopting climate-smart agriculture to mitigate the threats posed by climate change. In this article, we delve deeper into the discussion by advocating specific integrative approaches to agriculture that align with the Food and Agriculture Organization's (FAO) goals of achieving sustainable agricultural growth, climate change adaptation and reduction in greenhouse gas emissions. Additionally, we address the existing challenges in adopting these methods and explore the subsequent opportunities within this segment.

Integrative approaches to climate-smart agriculture

Integrative approaches to CSA offer a holistic and effective strategy to tackle the challenges posed by climate change in Indian agriculture. They can assist farmers in enhancing productivity, optimising resource utilisation and building resilience in their agricultural systems. Some of the approaches are as follows:

- 1) **Intercropping:** Intercropping involves growing two or more crops simultaneously in the same field. It optimises land use and enhances productivity by leveraging complementary growth patterns and resource utilisation. It diversifies income streams for farmers and promotes resilience to climate variations as the failure of one crop could be offset by the success of another.
- 2) **Green manuring:** Green manuring involves growing specific plants, often legumes, such as clover or alfalfa and incorporating them into the soil while they are still green and growing actively. These plants fix nitrogen from the atmosphere and transfer it to the soil when they decompose. This process enriches the soil with essential nutrients, reducing the need for synthetic fertilisers. Green manuring also improves soil structure, water-holding capacity, and overall fertility.
- 3) **Mulching:** Mulching involves covering the soil around plants with organic materials such as straw, leaves, or crop residue. This protective layer conserves soil moisture, reducing water evaporation and minimising the impact of extreme temperatures on plant roots. It also improves soil fertility, promotes plant growth and is highly effective in regions with water scarcity.
- 4) **No tillage:** No tillage, also known as zero tillage or direct seeding, is a conservation agriculture practice where crops are planted without ploughing or extensively disturbing the soil. This preserves the soil structure, reduces erosion and promotes water infiltration and retention. It also enhances organic matter content in the soil, increasing carbon sequestration.
- 5) **Agroforestry:** Agroforestry involves integrating trees and shrubs with crops or livestock on the same piece of land. This diverse and multi-layered system provides numerous benefits. Trees act as windbreaks, reducing soil erosion and protecting crops from extreme weather events. They also provide shade, improving animal welfare and reducing heat stress for livestock, along with offering additional income sources for farmers. These systems contribute to carbon sequestration, augmenting climate change mitigation efforts.
- 6) **Water conservation:** Water conservation practices involve efficient water usage and management in agriculture. These includes techniques such as drip irrigation, where water is delivered directly to plant roots, minimising wastage and maximising water use efficiency. It also includes rainwater harvesting, which captures and stores rainfall for agricultural use during dry periods, reducing reliance on external water sources.
- 7) **Fertigation:** Fertigation is the practice of applying fertilisers through irrigation water. This precise application of nutrients directly to the root zone enhances nutrient use efficiency and reduces nutrient leaching, thus minimising environmental pollution.
- 8) **Leveraging ICT initiatives:** Information and communication technology (ICT) initiatives can revolutionise agricultural practices by providing farmers with timely information and guidance. Farmer call centres and mobile applications offer farmers access to agricultural experts and weather forecasts, enabling them to make informed decisions about crop management, pest control, and market prices.

- 9) **Precision agriculture:** Precision agriculture employs modern technologies such as remote sensing, geographic information systems and global positioning systems to optimise farm management. By analysing data on soil health, weather patterns, and crop growth, farmers can make informed decisions on irrigation, fertilisation, and pest control, reducing resource wastage and increasing efficiency.
- 10) **Climate-resilient crop varieties:** Adopting climate-resilient crop varieties is essential to ensure agricultural productivity in the face of changing climatic conditions. Scientists and breeders are developing drought-tolerant, heat-resistant, and disease-resistant crop varieties. These varieties are better suited to withstand extreme weather events, ensuring stable yields and food security.

Key challenges and opportunities

This segment explores the key challenges faced by Indian farmers in adopting climate-smart agriculture and highlights potential opportunities for a sustainable and resilient agricultural future.

C Challenges ✓	O Opportunities ✓
1 Lack of awareness and knowledge around CSA leading to poor farming techniques affecting soil health and productivity.	Strengthen agriculture extension services and promote farmer-to-farmer knowledge on CSA through collaborative efforts by stakeholders.
2 Limited access to modern technology and inputs such as climate resilient seeds, precision irrigation system, weather forecasting tools etc.	Collaboration between public, private and civil societies can facilitate transfer of technologies to farmers with focus on community based approaches.
3 Limited financial inclusion with low scope of credit and insurance hinders farmers' ability to invest in CSA practices.	Development of innovative financing mechanisms, such as CSA focused loans and insurance products, tailored to the needs of smallholder farmers.
4 India's fragmented landholding system (small land size and tenure farming) hinders the adoption of large-scale CSA practice.	Encouraging farmer cooperatives and land consolidation initiatives to pool resources and collectively adopt CSA , while promoting sustainable land-use