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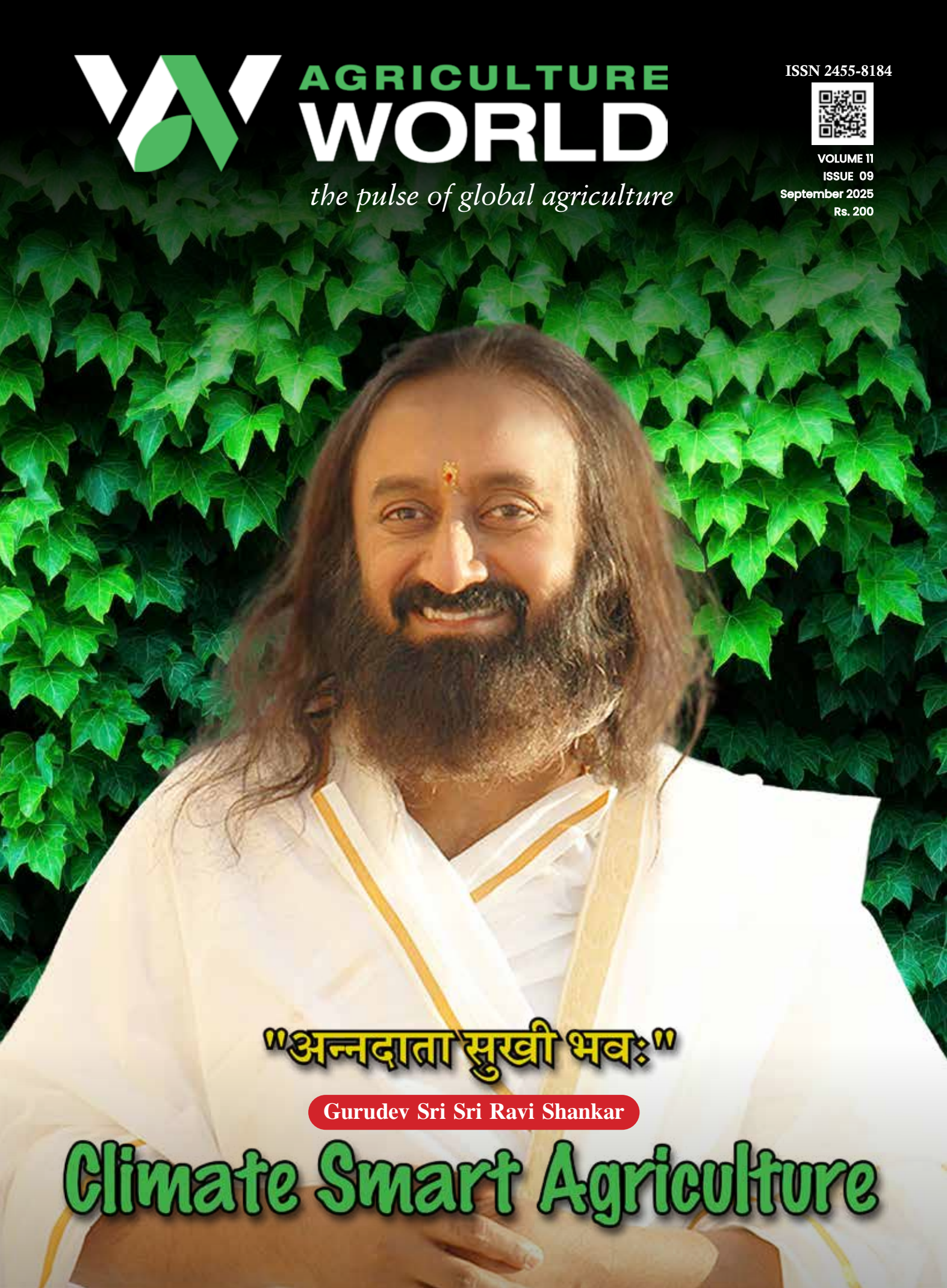

"अन्नदाता सुखी भव:"

Gurudev Sri Sri Ravi Shankar

# Climate Smart Agriculture

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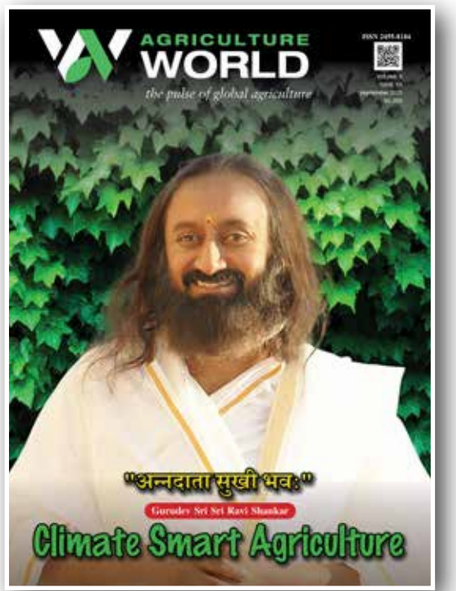


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# CONTENT





# Building a Climate-Resilient, Future-Ready Bharat

**FMR. M C DOMINIC**
Founder & Editor-in-Chief Krishi Jagran and Agriculture World
Founder & President -Agriculture Journalist Association of India (AJAI)
Founder & Managing Trustee - MAC Krishi Jagran Foundation

Across India's fields and farmsteads, a quiet revolution is taking root. Faced with the escalating challenges of climate change, declining soil health, and malnutrition, our agricultural sector is responding with resilience, innovation, and intent. No longer defined by crisis, Indian farming is being redefined by climate-smart solutions, inclusive reforms, and nutrition-driven practices. This issue of Agriculture World brings these bold transformations into focus, charting a new course for 21st-century agriculture rooted in sustainability, equity, and empowerment.

The future of Indian agriculture lies not in resisting change, but in shaping it. Climate-Smart Agriculture (CSA) has emerged as a powerful framework, enabling farmers to increase productivity, adapt to extreme weather, and reduce their environmental footprint. Whether it is the use of water-efficient irrigation, drought-resilient crop varieties, or real-time agrometeorological data, CSA is transforming vulnerable landscapes into resilient ecosystems.

But resilience is not only about adapting to climate; it is also about nourishing people. With more than a third of Indian children under five facing stunting, biofortification offers a game-changing solution. Iron-rich millets, zinc-enhanced wheat, and vitamin A-enriched sweet potatoes are delivering both yield and nutrition to millions, particularly in low-income and agriculture-dependent communities.

Importantly, these advances are no longer confined to research plots. They are being adopted by smallholders, women farmers, and Farmer Producer Organizations (FPOs) across India, supported by seed companies, Krishi Vigyan Kendras, digital agri-platforms, and government initiatives. This convergence of innovation, policy, and grassroots leadership is laying the foundation for a truly resilient rural economy.

Yet, significant challenges remain. Scaling CSA will require bold investments in finance, insurance, seed systems, and community-led adaptation. Biofortified crops must be mainstreamed into public procurement and nutrition campaigns. Most importantly, agricultural policies must evolve to align incentives, subsidies, and procurement systems with our climate and nutrition goals.

This issue is a call to action. A future-ready Bharat will be built not only on climate resilience, but on farmer empowerment, scientific foresight, and inclusive growth. At Agriculture World, we remain committed to capturing and catalyzing this transformation.

# Empowering Agriculture for a Resilient Tomorrow

Farming is no longer seen through the lens of subsistence alone. It is a space of innovation, leadership, and national relevance. As climate change intensifies and nutritional challenges deepen, the role of farmers has expanded far beyond the field. They are now at the center of solutions for food security, environmental stability, and rural transformation.

In the pages ahead, we see how practical approaches like climate-smart agriculture are helping farming communities adapt and thrive. Whether it is precision irrigation, integrated livestock systems, or eco-friendly crop practices, these methods are empowering farmers to respond to climate pressures while building economic resilience.

At the same time, the rise of biofortified crops is addressing a quiet but urgent crisis in rural health. By cultivating crops that are rich in essential micronutrients, farmers are not only improving yields but also contributing to better nutrition in their communities. These innovations are creating a future where nutritious food is grown locally and consumed widely.

For these efforts to scale, support systems must evolve. This includes rethinking subsidies, ensuring fair pricing for climate-resilient crops, and investing in infrastructure, insurance, and local market access. Strong collaboration between public institutions, private players, and community organizations will be key.

Equity must remain at the core of this transition. Women farmers, youth, and smallholders are central to rural economies and must be supported with targeted resources and leadership opportunities. Their knowledge, resilience, and energy are critical to sustaining the momentum of change.

This is not just a shift in farming practices. It is a shift in mindset. From the ground up, we are witnessing a new chapter in Indian agriculture, one rooted in sustainability, driven by innovation, and powered by people.

Let us continue to uplift the hands that feed the nation and reimagine farming as a pillar of strength, resilience, and pride.

**SHINY DOMINIC**
Managing Director





# Climate Smart Agriculture: A Pathway to Food Security and Sustainability

Climate Smart Agriculture (CSA) represents a pivotal approach to addressing the challenges posed by climate change while ensuring sustainable agricultural practices and food security. This innovative framework integrates three main objectives: enhancing productivity and incomes, building resilience to climate change, and reducing greenhouse gas emissions. As climate effects intensify, CSA emerges as a crucial strategy to safeguard global food systems and rural livelihoods.

At its core, CSA promotes practices and technologies tailored to local conditions that optimize resource efficiency. These include improved soil management like conservation tillage and agroforestry, precision agriculture using weather data and digital tools, and crop diversification to reduce risks linked to changing climates. Through these, farmers achieve better yields, conserve resources, and lower their carbon footprint.

Adaptation is central to CSA, equipping farmers to withstand climate variability. It promotes resilient crop varieties, efficient irrigation systems, and early warning systems for weather risks. CSA also values traditional knowledge alongside modern innovations, boosting adaptive capacity in farming communities.

Mitigation under CSA involves reducing agriculture's greenhouse gas emissions. Improved livestock practices, methane capture from manure, renewable energy use, reforestation, and sustainable forest management contribute to lowering environmental impacts and enhancing carbon sequestration.

CSA benefits extend beyond environmental protection. By improving resilience and productivity, it enhances food security, especially in regions vulnerable to climate shocks. Smallholder farmers, disproportionately affected by climate change, can greatly benefit through increased incomes and reduced poverty.

Policy support and institutional collaboration are crucial for scaling up CSA initiatives globally. Governments, international organizations, and private sectors play pivotal roles in facilitating research and development, providing financial incentives, and fostering knowledge exchange. Robust policies that incentivize CSA adoption and integrate climate considerations into agricultural planning are essential.

This edition on Climate Smart Agriculture deliberates on the paradigm shift towards a resilient, productive, and sustainable sector. Embracing CSA is imperative for food security, agricultural sustainability, global climate goals, and building resilient communities worldwide.

**MAMTA JAIN**
Group Editor & CEO

# Chemical Free Farming can ensure a Healthier Tomorrow: Vision of Gurudev Sri Sri Ravi Shankar

**GURUDEV SRI SRI RAVI SHANKAR**
Indian guru and spiritual leader

In today's times, there is excessive use of chemical fertilizers, pesticides, and hybrid seeds. This not only pollutes water and soil but also reduces soil fertility. Moreover, farmers are forced to take heavy loans to buy these inputs, which further increases their difficulties.

At such a time, the Sri Sri Natural Farming Program initiated by the Art of Living has emerged as a cost-effective, sustainable, and eco-friendly alternative. This method is based on India's traditional farming practices, which were once widely followed when the country's economy was largely dependent on agriculture.

During the Green Revolution of the 1960s, the use of chemical fertilizers and hybrid seeds certainly increased production, but it also burdened farmers with debt and harmed the environment. Now, there is once again a need for a new agricultural revolution—one that empowers farmers, sustains soil health, and protects the environment.

In this direction, the Art of Living has been training farmers across the country in natural farming techniques. Trainers not only explain the theory but also demonstrate the practices in fields. They highlight the importance of indigenous seeds, native cows, organic manure, and natural pesticides.

Behind this movement is the vision and inspiration of the founder of the Art of Living and globally renowned spiritual leader, Sri Sri Ravi Shankar. On this subject, Krishi Jagran's Group Editor Mamta Jain had an exclusive conversation with him. Here are the key excerpts from that interview:

Question: Among all your agricultural initiatives over the years, which has been the most impactful and inspiring success story?

Sri Sri Ravi Shankar: In Telangana, where there is severe water scarcity, farmers used to earn only ₹10,000–20,000 from chili farming. Now, after adopting natural farming, those same farmers earn up to ₹4 lakh. Similarly, there are examples of pomegranate farming in Maharashtra.

In Punjab, there was an ancient wheat variety that we named Sona Mati. This wheat contains folic acid and vitamin B12, which are not found in regular wheat. It is especially beneficial for people with gluten intolerance. A few people had preserved this seed in an ashram; we obtained it from them and expanded its cultivation.

Unfortunately, big companies often buy up indigenous seeds, forcing farmers to purchase commercial ones. But seeds like Sona Mati are highly beneficial for health.

In Karnataka, there are nearly 1,200 rice varieties. We have conducted studies (bojkos) on several of them. Preserving and promoting these rare varieties is one of our main goals.

Similarly, we have preserved around 600 ancient medicinal herbs. Among these, 27 were already declared "extinct" by the United States, yet we have safeguarded them here.

Seed preservation is extremely important. There are countless such success stories to share.

Question: How can people who are not farmers themselves contribute to natural farming?

Sri Sri Ravi Shankar: I give everyone one simple mantra—before eating, say "Annadata Sukhi Bhava" (May the food provider be happy). This prayer includes the farmer who grows the grain, the woman who cooks and serves it, and the trader who delivers it.

If traders adulterate food, it can make people sick. If the woman at home serves food unhappily, it does not digest properly. Therefore, we must be mindful of all these aspects.

I advise everyone to consciously choose food grown through natural farming. This supports farmers, keeps the land healthy, and creates peace and well-being in society.

Question: Women play a vital role in agriculture, but their contribution is often underrecognized. What initiatives have you undertaken for women empowerment in farming?

Sri Sri Ravi Shankar: We created a separate women's wing for empowerment. Many women have emerged as farmers and are now running successful businesses, with their trade growing up to five times.

There is often a misconception that natural farming is unprofitable, with low yields and poor market value. But the truth is, only the first crop cycle may see slightly reduced yields. From the second cycle onward, farmers' profits can increase up to fourfold.

Many women are now actively engaged in this field. For example, earlier when chemical fertilizers and pesticides were used in pomegranate farming, only one crop was harvested. But with natural farming, the fruits are larger, and women farmers are reaping significant benefits.

Question: How does the Art of Living influence the farmers you work with?

Sri Sri Ravi Shankar: Whoever I meet, I encourage them to live stress-free lives through yoga, pranayama, and meditation. When farmers adopt these practices, their lives transform completely.

In Vidarbha, Maharashtra—where farmer suicides were rampant—we reached out to 548 villages and taught meditation. This brought about a significant positive change in the region.

Question: Over the past four decades, you have taught millions through the Art of Living how to live life meaningfully. What inspired you to take up natural farming?

Sri Sri Ravi Shankar: India has always been a land of Rishi Krishi (sage-guided agriculture). From ancient times, we practiced natural farming, and we wanted to revive this tradition. We started it from our own ashram.

The pain and struggles of farmers are rooted in chemical farming. Farmers take loans, buy chemicals, use them in fields, and end up with poor yields. Seeing this, we could not just sit back.

Since the founding of the Art of Living, agriculture has been an integral part of our work. For the past 45 years, we have been working in this direction. We brought together agricultural scientists to explore how natural farming could be implemented so that farmers remain profitable.

The result is that over 30 million people across India have benefited, and millions of hectares of land have seen positive transformation.

# Animal Husbandry and Climate Change Plea for a Sane and Smart Response

**DR. TARUN SHRIDHAR**
Director General, Indian Chamber of Food and Agriculture, and former Secretary, Ministry of Fisheries, Animal Husbandry and Dairying, Government of India

It was sometime in the 1980s that the issue of global warming got a wide recognition, and since then its impact on agriculture and food production systems has emerged as a serious area of research. All evidence is a pointer towards an alarm; food production is expected to be the hardest hit, including in the regions which get to be called the breadbaskets of the world; and India is not only one but sits atop with a chosen few. Despite concerted measures for mitigation and adaptation, some scientists estimate that reduced availability of food would mean a loss of 120 calories per person for each additional degree of rise in global temperature. A heating planet poses the biggest threat to food and nutritional security. And even more than agriculture, it is the livestock that is threatened the most as in addition, it also faces multiple attacks from diverse individuals and groups. A basic google search throws up derisive and derogatory comments about livestock as the perpetrator of climate change and global warming caused by Greenhouse Gas (GHG) emissions. Alas! The victim is being hounded as an accused. What compounds this travesty is that it is the celebrities and ideologues whose voices are the loudest, driven more by sentiment and ill-founded belief rather than science or any rationale.

In a recent conference I attended, a speaker proclaimed that agriculture is both a culprit and a victim of climate change, but then qualified that livestock happens to be the bigger culprit, while crops were the bigger victim. It is such misgivings, rooted less in science and more in populist jingoism, that tend to stigmatise an important sector of our economy. The livestock sector is routinely vilified as a major contributor, now curiously termed culprit, to environmental damage and climate change. A call to adopt vegan lifestyle is another offshoot of this clamour, without realising that such a call not only compromises nutritional security but also hits at the livelihoods of millions of livestock farmers, majority being poor. Reduced consumption, if not outright elimination, of meat and dairy products would arrest the problem of climate change is the view these activists hold, albeit without any empirical data. Unfortunately, many responsible organisations, even international ones follow suit as such views project them as sensitive and concerned entities.

Powerful voices in the developed world that influence global agenda have begun to question the how, and how much of the animal protein we should produce. Perhaps they have missed out that all this while, in other parts of the world, many are experiencing extreme hunger, malnutrition and poverty; and access to sufficient livestock foods is a far cry for them. At the same time, national governments through the United Nations, have agreed to work towards achieving the Sustainable Development Goals (SDGs); a collaborative effort to tackle the severest of global problems such as hunger, poverty, pollution and climate change. Despite the irony of the situation, what is appreciable is that along with the commitment to the SDGs is the declaration to move towards prosperity for all. This is not to undermine the problem; the challenge posed by climate change, greenhouse gas emissions in particular, is serious; and the livestock sector too needs to become smarter and resilient to stand up to it. Therefore, let us analyse and understand the issue scientifically and dispassionately.

The gases in the atmosphere that absorb radiation are known as greenhouse gases because they are largely responsible for the greenhouse effect, which in turn, is one of the leading causes of global warming. The most significant greenhouse gases are water vapor, carbon dioxide, methane and nitrous oxide. The argument against livestock centres around the methane produced by livestock, particularly by the cows. Concentration of methane in Earth's atmosphere is small (around 1.8 parts per million), but it is an important greenhouse gas because it is a potent heat absorber. The concentration of methane in our atmosphere is said to have risen by about 150% in the past 275 years or so, primarily due to ever expanding human activities. Methane accounts for about 20% of the heating effects by all of the greenhouse gases combined. Both natural and human sources supply methane to Earth's atmosphere. Major natural sources of methane include emissions from wetlands and oceans, and from the digestive processes of termites. Sources related to human activities include rice production, landfills, raising cattle and other ruminants, and energy generation.

It is abundantly clear that livestock is only one of the several sources of atmospheric methane. Moreover, innumerable studies conclude that of all the greenhouse gases attributed to anthropogenic activities, the contribution of livestock is only 14.5%. Besides the animals' digestive emissions, this includes emissions from transportation of the produce from farm to table, the gases' footprint from growing feed; and food processing. It is evident that the figure has been upped to 14.5% artificially. Therefore, we all would be well advised to shun the ever growing tendency to blame the farmers for everything that goes wrong with the urban air quality. In fact, we should celebrate their remarkable achievement of producing food without overwhelming our limited resources.

Let us not forget that global warming and the greenhouse gases that cause it occur naturally; without them, earth's average surface temperature would be minus 18 degree Celsius. Try living in such conditions. So for life on this planet to survive and thrive, greenhouse gases are a critical necessity. The cause of concern is that the amount of greenhouse gases in the atmosphere has skyrocketed to detrimental levels in the recent past, thus upsetting the temperature balance.

Human population is expected to increase from 7.2 to 9.6 billion by 2050 . This represents a population increase of 33%, and as the global standard of living increases, demand for agricultural products is projected to increase by about 70% in the same period. Meanwhile, total global cultivated land area has not changed since 1991, nor is it likely in future. If anything, the indicators point towards its shrinkage. Lack of expansion has been compensated, to some extent, by increased productivity and intensification of agriculture.

Livestock products provide 17% of global calorie and 33% of global protein consumption. The sector contributes to the livelihoods of more than one billion of the poorest people in the world. The demand for livestock products has been consistently and impressively growing over the past decades. In fact, its rapid growth in developing countries has been characterised as the ''livestock revolution". Demand for animal products is expected to scale up with the growing global population. Therefore, worldwide livestock production is registering a consistent increase in response to demands from an increasingly affluent and urbanised population. According to the United Nations' Food and Agriculture Organisation (FAO), demand for animal-source foods (ASF) in low and middle-income countries more than quadrupled from 1970 to 2012. Though growth had slowed thereafter, demand is still predicted to increase by 35 percent from 2012 levels by 2030, and by 50 percent by 2050.

Along with the gains in production efficiency, GHG emissions from livestock too are, obviously, on the rise. The Intergovernmental Panel on Climate Change (IPCC) special report flags considerable emissions originating from the Agriculture, Forestry, and Livestock sectors; livestock, as stated earlier, is estimated to generate between 14 to 15 percent of global anthropogenic GHG emissions, with cattle contributing nearly two thirds of this. National commitments to reduce GHG emissions are, therefore, expected to include livestock systems in climate change mitigation and adaptation plans. Successful action on climate change through practical action in livestock agrifood systems is an urgent priority, but it must not come at the expense of other sustainability objectives, particularly those relating to ending poverty and achieving zero hunger by 2030. Hence, the FAO advocates a balance between the benefits of livestock for nutrition, health and well-being, and the pressing need to reduce GHG emissions to tackle the climate crisis, which too threatens food security. "Low-carbon livestock" would help create a balance whereby ASF, such as meat, milk, eggs, cheese and yoghurt feed the hungry and malnourished, yet are produced in a way that minimises the overall output of greenhouse gases. And while there are many opportunities to reduce livestock-related emissions, the FAO estimates that improved management practices alone could reduce net emissions from livestock systems, methane in particular, by about 30 percent.

Climate change is a global problem that demands integrated solutions at local, national, and regional levels. So the burdens should be addressed, rather than shifted. Shaping a sustainable future will depend on understanding the diversity and complexity of livestock systems and the particular challenges stakeholders face against the odds of climate change. What works for a producer in a capital-intensive system can be very different from what works for a pastoralist or a mixed crop-livestock smallholder. Sustainable action means respecting these differences, and working closely with these diverse stakeholder groups to develop relevant and practical actions for everyone. Our policies and interventions, inter alia, should aim at boosting efficiency of livestock production and resource use; intensifying recycling efforts and minimising losses for a circular bioeconomy, capitalising on nature-based solutions to ramp up carbon offsets, striving for healthy, sustainable.

Livestock stands apart from other sectors because it is organic, so carbon can never be eliminated from it, as it could for example from the transport or energy sectors. The key to promoting "climate smart" practices is simple: improve productivity and resource use efficiency. Emission intensities vary widely within and across livestock systems, particularly for ruminants. Adoption of better management practices would result in production efficiency. Technological innovations such as improved feeding, genetics, animal health, general husbandry and information technology are scaling up productivity, making resource use more efficient and with a potential to reduce environmental impact.

Agrifood systems rely on natural resources as primary inputs. However, the future of food would remain under threat if resources are consumed unsustainably and inefficiently. FAO encourages promoting a circular bioeconomy, i.e. recycling resources at every possible step in agrifood systems and thus minimising the loss of resources and nutrients. Countries making better use of the biomass would see better economic and environmental returns. Unused crop residues, food waste, and agro-industrial by-products are lost opportunities to recycle and optimise resource use efficiency and can be repurposed for animal feed. Manure and slaughterhouse waste can be used to generate fertiliser and biogas as a source of renewable energy.

The Global Livestock Environmental Assessment Model (GLEAM) of the FAO takes a life cycle assessment approach to estimating emissions from livestock systems. It is a GIS framework that simulates the biophysical processes and activities across the livestock supply chains. The aim of GLEAM is to quantify and identify environmental impacts of livestock so that appropriate adaptation and mitigation scenarios could be created for a more sustainable livestock.

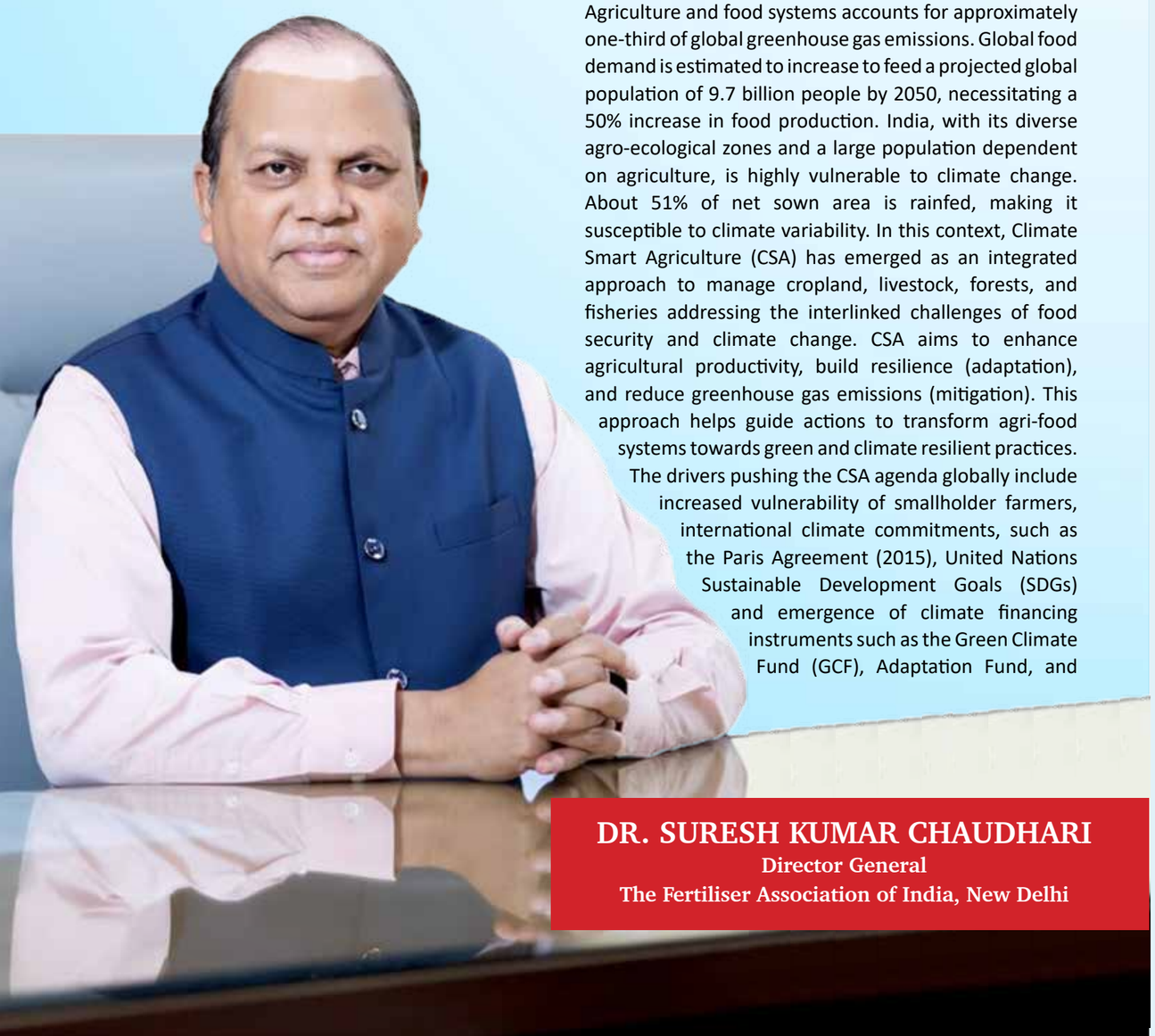
Looking across livestock species in GLEAM, cattle are the main contributors to GHG emissions, producing about 5 gigatonnes (Gt) CO2 equivalent (eq.) per year, accounting for more than 60 percent of all livestock emissions. Pigs, chickens, buffaloes and small ruminants contribute much less, each representing between 7 and 10 percent of the sector's emissions. Total emissions (expressed in CO2 eq.) vary considerably by commodity, with those from cattle far outstripping the combined impacts of all other livestock species, accounting for over 60 percent of all livestock emissions. Emissions from beef cattle are greatest, followed by those from dairy cattle. The breakup in Gigatonnes emission CO2 eq. per year is as follows: Cattle beef: 3.2; Cattle milk: 1.6; Small ruminant meat: 0.4; Small ruminant milk: 0.2; Buffalo meat: 0.2; Buffalo milk: 0.5; Pork: 0.8; Chicken meat: 0.5; Chicken eggs: 0.3.

Another study of FAO categorically concludes that "Climate change has major impacts on livestock keepers and on the ecosystems, goods and services on which they depend". Climate change impacts livestock in multiple ways such as adverse changes in production patterns, quality of feed crop and forage, water availability, animal growth and milk production, diseases, reproductive health and cycle, biodiversity et al. Regions identified as the most vulnerable to climate change are Sub-Saharan Africa and South Asia. And these are also the regions where farmers and rural communities rely the most on livestock for food, income and livelihoods, and where livestock is expected to contribute increasingly to food security and better nutrition.

Livestock systems in these regions, especially in India, have evolved over a long period based on the availability and opportunities afforded by the diverse natural resource base supported by strong traditional knowledge, and in modern times also by robust scientific research. Since India is the biggest nation in South Asia, both in geography and population, it is imperative that we guard and protect our livestock from the debilitating effects of climate change; global warming to be specific, and not fall prey to the clamour and efforts to paint livestock farming as a perpetrator of the adverse climate phenomenon; rather livestock should be recognised as a victim of global warming and rescued. The GLEAM data too substantiates this. With no beef industry and negligible industrial dairy, how low our share in these greenhouse gases would be is anybody's guess.

Let us celebrate our livestock, encourage it to grow and become smart.

# Climate Smart Agriculture: Adaptation to Changing Environment



**DR. SURESH KUMAR CHAUDHARI**
Director General
The Fertiliser Association of India, New Delhi

## Introduction

Climate change is increasingly disrupting agricultural systems worldwide, threatening food security, farmer livelihoods, and natural resource sustainability. Agriculture and food systems accounts for approximately one-third of global greenhouse gas emissions. Global food demand is estimated to increase to feed a projected global population of 9.7 billion people by 2050, necessitating a 50% increase in food production. India, with its diverse agro-ecological zones and a large population dependent on agriculture, is highly vulnerable to climate change. About 51% of net sown area is rainfed, making it susceptible to climate variability. In this context, Climate Smart Agriculture (CSA) has emerged as an integrated approach to manage cropland, livestock, forests, and fisheries addressing the interlinked challenges of food security and climate change. CSA aims to enhance agricultural productivity, build resilience (adaptation), and reduce greenhouse gas emissions (mitigation). This approach helps guide actions to transform agri-food systems towards green and climate resilient practices. The drivers pushing the CSA agenda globally include increased vulnerability of smallholder farmers, international climate commitments, such as the Paris Agreement (2015), United Nations Sustainable Development Goals (SDGs) and emergence of climate financing instruments such as the Green Climate Fund (GCF), Adaptation Fund, and Nationally Determined Contributions (NDCs), which prioritize CSA-type interventions.

## Climate smart agriculture adaptation

Adaptation is central to climate smart agriculture. In the light of climate change, adaptation is recognized as actions aimed at reducing vulnerability and benefiting opportunities resulting from current and future changes. Two levels of agricultural adaptation are required: i) farm-based measures, which are built on the rational personal interests of farmers, and ii) policy-driven adaptation with government involvement, based on collective needs. The most severe repercussions of these changes are felt within local agricultural communities, as they directly affect employment, income sources, and agricultural production. Climate change adaptation actions can be 'incremental' when they aim to maintain the essence and integrity of a system or process at a given scale, or 'transformational' when they change the fundamental attributes of a system in response to climate and its effects. Climate-smart agriculture strategies may prompt both types of adaptation actions, which will however require different approaches for integration into policy planning and resource mobilization.

## Adaptation strategies under CSA

Strategies and actions for agricultural adaptation that can be emphasized at local and regional levels include crop management practices such as use of drought, flood, and heat-tolerant crop varieties, altered planting dates to match changing rainfall and temperature patterns and crop diversification to spread risk and enhance resilience. Soil and water management practices include conservation agriculture, integrated nutrient management using both organic and inorganic sources, rainwater harvesting, micro-irrigation, and other water-use efficiency measures. In livestock sector, the adaptive strategies include improved breeds resistant to heat and diseases, climate-resilient fodder systems, feed and shelter management, silvi-pastoral practices etc. Adaptive strategies in aquaculture, including water temperature monitoring, species diversification, and modified feeding practices. Agricultural adaptation is tightly linked to many other cross- or multi-sectoral adaptation issues. Cross-sectoral issues, such as early warning systems, disaster risk management, education, capacity development and climate information services are particularly relevant for agricultural stakeholders. While the primary goal of CSA is adaptation, it also offers significant mitigation co-benefits through carbon sequestration in soils through organic matter additions and agroforestry, reduced emissions from optimized fertilizer use and better manure management, methane reduction in rice cultivation through alternate wetting and drying (AWD) practices and shifting to low-emission livestock systems and reduced deforestation from agricultural expansion. CSA practices contribute to low-carbon pathways for agriculture without compromising productivity or income.

## International initiatives

Global Alliance for Climate-Smart Agriculture (GACSA) initiated in 2015 is an inclusive, voluntary and action-oriented multi-stakeholder platform on CSA which aims to catalyze and help create transformational partnerships on agriculture, forestry, livestock and fisheries that reflect an integrated approach to the three pillars of CSA. FAO engages with international financing institutions, such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF) and supports countries to access funds for the implementation of CSA projects. Group on Earth Observations Global Agricultural Monitoring (GEOGLAM) helps farmers and policymakers make informed decisions for climate-resilient farming. FAO's Economics and Policy Innovations for Climate-smart agriculture (EPIC) programme works with governments, research centres, universities and other institutional partners to support the transition to CSA by using sound economic and policy analysis. World Bank has also significantly scaled up its engagement and investments in CSA through its Climate Change Action Plan (2021-25), that identified agriculture, food, water and land as one of the five key transitions needed to tackle the Paris Agreement. It also

supports research programs such as with the CGIAR, which develops and supports climate-smart technologies and management methods, early warning systems, risk insurance, and other innovations that promote resilience and combat climate change.

International Fund for Agricultural Development (IFAD) supports climate adaptation in smallholder agriculture through Adaptation for Smallholder Agriculture Programme (ASAP). Adaptation of African Agriculture (AAA) initiative launched by Morocco in 2016 during COP22 to reduce climate vulnerability of African agriculture. In addition, several countries have their individual projects related to CSA such as Mitigation of Climate Change in Agriculture (MICCA) Programme in Kenya and United Republic of Tanzania; Benguela Current Commission (BCC) to support the fisheries sector of Angola, Namibia and South Africa; GEF funded projects in Bangladesh, Turkey, Kazakhstan, Kyrgyz Republic, Tajikistan, Turkey and Turkmenistan; International Centre for Agricultural Research in the Dry Areas (ICARDA) working to scale-up the adoption of proven CSA field interventions in Egypt, Jordan, Morocco, Tunisia etc.

## National Initiatives in India

The Government of India has initiated several schemes and programs viz., National Mission for Sustainable Agriculture (NMSA), which is a part of National Action Plan on Climate Change (NAPCC) dealing with sustainable agriculture practices including several sub-missions focusing on conservation of natural resources and carbon sequestration. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) – Per Drop More Crop (PDMC) was launched to enhance on-farm water use efficiency through micro-irrigation systems. The Pradhan Mantri Fasal Bima Yojana (PMFBY) offers financial protection against crop loss due to climatic shocks. Green India Mission (GIM) outlined under NAPCC with an objective to protect, restore and enhance the diminishing forest cover in India. The ICAR has evolved several rainfed agriculture technologies, which are being upscaled through the Integrated Watershed Management Program (IWMP) and Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS). National Innovations in Climate Resilient Agriculture (NICRA) is a flagship project of Indian Council of Agricultural Research (ICAR) with a mission to enhancing the resilience of Indian agriculture to climate change through application of improved technologies and new policies. NICRA experiences lead to the implementation of similar projects such as Project on Climate Resilient Agriculture (PoCRA) in Maharashtra, Climate-Resilient Agriculture (CRA) Programme in Bihar and Drought Proofing initiative in Odisha. The private sector programs include ITC-eChoupal covering 10 States strives to build climate resilience and reduce the risk of farmers in its agri value chains through focused interventions. Corporate Social Responsibility (CSR) funds also promotes climate

resilient practices like direct seeded rice (DSR) cultivation in several states.

Several international collaborative projects lead by India such as Consortium for Scaling-up Climate Smart Agriculture in South Asia (C-SUCSeS) program fosters partnership and cooperation between the SAARC to promote sustainable and resilient agricultural intensification in South Asia through enhanced capacity (policy, institution, and skill) to scale up climate smart agriculture strategies and technologies. The ICAR-Borlaug Institute for South Asia (BISA) collaborative project 'Atlas of Climate Adaptation in South Asian Agriculture (ACASA)' offers a unique set of tools that can facilitate improved investment targeting and priority setting, and support stakeholder's decision making and investments in agricultural technologies, climate information services, and policies.

## Challenges and strategies for scaling up CSA

Although there have been several efforts to upscale the climate resilient practices, their reach and impact remain largely confined to limited area. Most of the programmes are in pilot scale and experiences of such are not upscaled to reach wider farming community due to technical, social, financial and policy level challenges to adopt CSA on a wider scale before it reaches the end users. Thus, there is a need to strengthen climate services and agro-advisories, enhance research-extension-farmer linkages, incentivizing sustainable practices through carbon markets and green finance, promote community-based adaptation models, custom hiring centers and use Geographic Information Systems (GIS) and AI to identify hotspots and design localized interventions. A shift towards landscape-level planning, inclusive governance, and gender-sensitive strategies is essential for CSA to reach its full potential.

## Policy and institutional frameworks

Effective implementation of CSA requires enabling policies, governance mechanisms, and cross-sectoral coordination such as National Adaptation Plans (NAPs), climate-smart investment plans, mainstreaming CSA into agriculture and rural development policies, subsidy reforms to favour climate-resilient inputs and technologies and incentivizing private sector investment and public-private partnerships. International collaboration and south-south cooperation are also vital in sharing best practices, technologies, and financing. As climate risks intensify, the urgency to scale CSA becomes critical with not just as an adaptation imperative but as a holistic pathway for food security, farmer welfare, and environmental sustainability. Investing in CSA today will secure the future of agriculture tomorrow.

# Farming for the Future: Climate-Smart Agriculture in South Asia

**DR. NUTAN KAUSHIK**
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Climate change is no longer a distant threat—it's a daily challenge for farmers across South Asia. Rising temperatures, unpredictable rainfall, salinity intrusion, and extreme weather events like floods and droughts are making traditional farming methods increasingly unreliable. But there is hope. Through innovative technologies and practices, farmers in India, Bangladesh, and Afghanistan are now adopting Climate-Smart Agriculture (CSA) to sustain their livelihoods and feed growing populations.

This article highlights some of the most promising CSA strategies identified through years of collaborative work involving scientists and farmers from across South Asia and Australia

## What Is Climate-Smart Agriculture?

CSA is not a single technology or solution. It is an integrated approach that seeks to:

- Increase agricultural productivity, even under adverse conditions
- Enhance resilience to climate impacts like floods, droughts, or heat waves
- Reduce greenhouse gas emissions from agriculture

By combining traditional knowledge with modern science, CSA helps farmers adapt to changing conditions while improving their soil, water, and crop health.

## The Challenge: Climate Impacts on Farming

In India, a 1°C rise in temperature can reduce wheat production by 6 million tons annually. Droughts have become more frequent, and new pests are attacking previously safe crops.

In Bangladesh, saltwater intrusion has affected large areas of farmland, especially in coastal regions. Floods and rising temperatures are threatening staple crops like rice and jute.

Afghanistan faces extreme water scarcity and shifting rainfall patterns, making traditional rainfed agriculture less viable. Limited infrastructure and political instability add to the complexity.

## Local Solutions for Local Problems

Every region requires specific strategies based on its climate risks. Scientists working on this project have classified technologies and practices based on different "climate hotspots"—areas prone to drought, flood, salinity, or heat stress.

Here are some of the most effective approaches:

### For Drought-Prone Areas:

- **Millet, cowpea, and maize** are replacing water-hungry crops.
- **Mini ponds and rainwater harvesting** help conserve water.
- **Mulching and deep tillage** improve soil moisture retention.

### For Flooded or Waterlogged Regions:

- **Floating bed cultivation** allows vegetables to grow on water bodies.
- **Rice-duck systems** integrate ducks in paddy fields to reduce pests.
- **Flood-tolerant rice varieties** like Swarna Sub-1 are gaining popularity.

### For Saline Soils:

- Use of **salinity-tolerant crops** like sugarcane, kohlrabi, sweet potato.
- **Raised beds and ditch-dyke systems** help manage saltwater intrusion.
- **Rice-fish-vegetable systems** combine income and resilience.

### Smart Technologies: A Farmer's Toolkit

**1. Zero Tillage**

Leaving crop residues in the field and avoiding ploughing conserves soil health, saves fuel, and reduces carbon emissions.

**2. Direct-Seeded Rice (DSR)**

This technique saves up to 50% of water by skipping puddling and transplanting. It's ideal for water-stressed regions.

**3. Protected Cultivation**

Polyhouses and net-houses protect vegetables and fruits from heat, pests, and rain, enabling year-round production.

**4. Soil Health Management**

Practices like crop rotation with legumes, compost use, and integrated nutrient management help build soil fertility.

**5. Water-Saving Irrigation**

Techniques like drip and sprinkler systems can save up to 90% of water compared to flood irrigation.

**6. ICT-Based Advisories**

Mobile apps and SMS alerts provide farmers with weather forecasts, pest warnings, and best practices.

**7. Zero-Energy Cooling Chambers (ZECCs)**

These low-cost structures, built with bricks and sand, use evaporative cooling to keep vegetables fresh without electricity—ideal for rural markets.

### Nature-Based and Low-Cost Innovations

**Grafting** is being used to produce vegetable seedlings that can survive floods or heat waves by combining stress-tolerant rootstocks with high-yielding varieties.

**Relay Cropping,** where a new crop is sown before the previous one is harvested, helps optimize land use, reduce input costs, and improve soil health.

**Leaf Colour Charts** help rice farmers apply the right amount of nitrogen fertilizer, reducing cost and environmental harm

### Future Smart Foods

Climate-resilient traditional crops like millets, lentils, jackfruit, and amla are now being recognized as "Future Smart Foods" due to their low water needs and high nutritional value.

### Policy and Institutional Support

Governments are playing a key role in scaling up these solutions. India, for example, has launched climate-resilient village clusters in vulnerable districts. District contingency plans, mobile apps like PESTPREDICT, and seed banks for stress-tolerant varieties are helping farmers prepare for extreme weather.

Training programs in collaboration with agricultural universities and Krishi Vigyan Kendras are promoting farmer-to-farmer learning.

### Building a Climate-Resilient Future

The science is clear—climate change is here, and its impact on agriculture is undeniable. But solutions also exist. Through participatory research, practical demonstrations, and policy support, we can empower farmers to adopt resilient practices.

Farmers are not just victims of climate change—they are the frontline innovators. Climate-smart agriculture is about giving them the tools, knowledge, and confidence to farm sustainably, now and for future generations

### Box: Key Takeaways

- Climate-smart agriculture increases productivity, resilience, and sustainability.
- Local solutions like floating beds, drought-tolerant crops, and relay cropping are proving effective.
- Smart tools—zero tillage, drip irrigation, and ICT advisories—help farmers save resources.
- Soil and water conservation are central to building long-term resilience.
- Traditional crops like millets are climate champions for the future.


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## Exploring the power of collective action

# Celebrating the International Year of Cooperatives 2025

It was a crisp morning in a small village in Maharashtra when a group of farmers gathered under a banyan tree. Their faces reflected years of struggle, fighting against middlemen, fluctuating prices, and mounting debts. But today was different. They had come together, not as individuals, but as a collective, a cooperative. With pooled resources, shared knowledge, and newfound bargaining power, they could finally see a future where they controlled their own destinies. This story is not unique; it is the story of millions who have found strength in unity through cooperatives. As the world face complex social, economic, and environmental challenges, the spirit of cooperation stands as a beacon of resilience and progress. Recognizing the transformative potential of collective action, the United Nations has designated 2025 as the International Year of Cooperatives under the theme "Cooperatives Build a Better World." This global initiative underscores the vital role of cooperatives in fostering inclusive growth, sustainable development, and economic democracy.

From rural agricultural cooperatives empowering farmers to financial cooperatives ensuring equitable access to resources, these member-driven enterprises embody principles of mutual aid, shared responsibility, and social equity. As we embark on this year of celebration and reflection, we explore how cooperatives continue to shape economies, uplift communities, and contribute to a more just and sustainable world.

### The Global Cooperative Movement and the World Cooperative Act

Cooperatives have long served as engines of economic empowerment and community development. The World Cooperative Act was introduced to create a unified framework for cooperative societies globally, fostering collaboration, knowledge-sharing, and legal recognition. While cooperatives have thrived in many countries, challenges such as lack of access to capital, weak governance, and policy constraints have hindered their growth in others. Success stories include the Mondragon Corporation in Spain, one of the largest worker cooperatives globally, and the Cooperative Bank in the UK, which has championed ethical banking practices. However, failures such as the decline of cooperative banks due to mismanagement and political interference in some regions highlight the need for robust regulatory frameworks.

### The Indian Cooperative Movement

India has a rich history of cooperative movements dating back to the early 20th century. The Indian Cooperative Societies Act of 1912 laid the foundation for formal cooperative institutions. Over the years, the cooperative sector has seen remarkable successes, especially in agriculture, dairy, and banking. The Amul model is a prime example of cooperative success, transforming India into the largest producer of milk globally. However, the sector has also faced setbacks due to political interference, mismanagement, and lack of modernization. The failure of several cooperative banks and sugar mills in Maharashtra and Punjab illustrates the challenges that continue to plague the cooperative sector.

### India's initiatives to strengthen cooperatives

Recognizing the potential of cooperatives, the Government of India established a dedicated Ministry of Cooperation in 2021, under the leadership of Amit Shah. This initiative aims to streamline policy interventions, ensure better governance, and strengthen the cooperative ecosystem. The ministry focuses on addressing issues such as financial inclusion, professional management, and transparency within cooperatives. By implementing reforms, digitizing operations, and facilitating credit access, the government seeks to revitalize the cooperative sector and make it a significant contributor to India's economic development.

FPOs: A game-changer for cooperatives and agriculture

The Government of India launched the 10,000 FPOs scheme, aiming to form and promote 10,000 Farmer Producer Organizations over five years. This initiative provides financial support of ₹18 lakh per FPO and credit guarantees of up to ₹2 crore to enable sustainable operations. The scheme focuses on improving farm productivity, ensuring fair prices, and enhancing farmers' incomes. While the program has seen success in many regions, challenges such as lack of awareness, limited capacity building, and bureaucratic delays need to be addressed to maximize its impact.

FPOs have emerged as modern cooperatives, providing small and marginal farmers with collective bargaining power, improved market access, and better financial security. Recognized under the Companies Act, FPOs differ from traditional cooperatives by ensuring greater autonomy, better governance, and market-oriented approaches. They serve as an effective instrument in achieving the Sustainable Development Goals (SDGs) by promoting inclusive economic growth, reducing poverty, and ensuring food security. The ability of FPOs to integrate small farmers into the value chain makes them a powerful tool for agricultural transformation.

### Success and challenges in promoting FPOs

Several FPOs across India have demonstrated success by improving farmers' market linkages and reducing dependency on intermediaries. Examples like the Sahaja Samrudha FPO in Karnataka, which specializes in organic farming, showcase how collective farming can lead to premium pricing and sustainability. However, many FPOs struggle with poor financial management, lack of professional leadership, and inadequate infrastructure. Strengthening governance structures, improving access to working capital, and providing skill development are crucial for ensuring the sustainability of FPOs.

### Cooperatives as gateways to achieve SDGs

Cooperatives and FPOs align closely with the UN's Sustainable Development Goals, particularly in poverty eradication (SDG 1), zero hunger (SDG 2), and decent work and economic growth (SDG 8). By enhancing financial inclusion, promoting sustainable farming practices, and improving rural livelihoods, they play a crucial role in driving socio-economic development. Strengthening these institutions through policy support, financial inclusion, and technological integration can accelerate progress toward achieving the SDGs.

As India gears up for the International Year of Cooperatives in 2025, there is an opportunity to reimagine and reinvigorate the cooperative sector. With the government's focus on cooperative reforms, the rise of FPOs and strategic investments in capacity building, the sector can become a powerful driver of economic and social transformation. While challenges persist, innovative policies, digital transformation, and strong governance frameworks can ensure that cooperatives and FPOs contribute meaningfully to India's growth story and the achievement of global sustainability goals.

# Reforming Agricultural Policies for Climate-Smart Farming in India


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India's agricultural landscape is a vibrant tapestry of diverse terrains, crops, and traditional practices, shaped by varied socioeconomic conditions and unpredictable climatic patterns. With its complex topography and recent climatic shifts—such as rising temperatures and erratic monsoons—Indian agriculture faces unprecedented challenges. The National Agricultural Research System (NARS) has made strides in developing climate-smart technologies, including drought-resistant crop varieties, efficient irrigation systems, and sustainable farming practices. Yet, the adoption of these innovations at the grassroots level remains limited, largely due to government policies that inadvertently promote unsustainable practices. This article explores how current agricultural policies, particularly around minimum support price (MSP), free electricity, and subsidy schemes, hinder the adoption of climate-smart practices and proposes actionable reforms to align policies with sustainable and climate smart agriculture.

### The Minimum Support Price Puzzle

The Minimum Support Price (MSP) policy, designed to ensure farmers receive fair remuneration, has been a cornerstone of Indian agriculture. However, its heavy bias toward rice and wheat—key food grain crops—has unintended consequences. In 2025-26, the MSP for paddy was set at ₹2,369 per quintal and for wheat at ₹2,425 per quintal, with several state governments offering additional bonuses, such as Chhattisgarh's ₹900 per quintal for paddy. Coupled with assured procurement—over 90% of paddy and wheat produced in states like Punjab, Haryana and Chhattisgarh is procured by the government—this policy incentivizes monoculture, discouraging crop diversification, ground water exploitation and bringing marginal lands under rice and wheat crops.

This focus on rice and wheat has led to significant environmental costs. For instance, rice cultivation, which requires intensive water use, contributes to groundwater depletion in states like Punjab, where groundwater levels have dropped by 0.7–1 meter annually in some regions. The practice of crop residue burning, particularly in rice-wheat systems, exacerbates air pollution, with Punjab alone burning 20 million tons of residue annually, contributing to 30% of Delhi's winter smog. These practices undermine climate-smart alternatives like crop rotation or cultivation of less water-intensive crops such as pulses, oilseeds and dryland crops like maize, jwar and bajara.

Policy Reform: To promote sustainability, MSP should be restructured to make pulses, oilseeds, and millets more financially competitive. The yields of most of these crops per unit area are lower than paddy and wheat. Hence MSP for these crops should be increased in such a manner that total economic output per unit area should match with rice and wheat. Further, similar procurement strategy for these crops should also be put in place. For example, considering the paddy productivity of 50 q/ha with MSP of Rs 2369 / q, the economic output will be Rs 1.18 lacs for paddy. Similarly, considering moong crop with productivity of 12 q/ha its MSP should be around Rs 10000 and ensuring procurement could encourage farmers to diversify crops, reducing water stress and improving soil health. A balanced MSP framework, coupled with assured procurement for diverse crops, would incentivize climate-smart practices.

### Free Electricity: A Double-Edged Sword

Free or heavily subsidized electricity for irrigation, a policy implemented in states like Punjab, Haryana, Tamil Nadu and Chhattisgarh to name a few, aims to support farmers but has led to rampant groundwater exploitation. In Punjab, where 80% of agricultural land relies on groundwater, the water table has declined below 600 feet in some areas, with an estimated 1.2 million tubewells pumping water round-the-clock. This overexploitation is unsustainable, as India extracts 251 cubic kilometers of groundwater annually, the highest globally, with agriculture accounting for 89% of this use.

Free electricity removes the incentive for efficient water use, discouraging adoption of climate-smart technologies like drip irrigation, which can reduce water use by 40–60%. Farmers often over-irrigate, leading to

soil degradation and reduced long-term productivity.

Policy Reform: Instead of free electricity, governments could adopt a reimbursement model. Farmers could pay electricity bills upfront, with the amount refunded directly to their accounts, encouraging judicious use. Alternatively, a fixed monthly payment could be provided to cover electricity costs, motivating farmers to adopt water-saving technologies to retain savings. Tamil Nadu's pilot program, which incentivizes solar pump use with cash transfers, has reduced groundwater extraction by 20% in select districts, offering a scalable model.

## Subsidy Schemes: Quality and Access Barriers

Government subsidy schemes for agricultural equipment, seeds, and fertilizers aim to make technology accessible but often fall short due to bureaucratic inefficiencies and corruption. In 2022, India allocated ₹1.4 lakh crore for agricultural subsidies, yet farmers frequently report receiving poor-quality equipment at inflated prices due to fixed supplier contracts. For instance, substandard drip irrigation systems supplied under subsidies cost 30–40% more than market alternatives, discouraging adoption of climate-smart technologies. Moreover, the centralized procurement process limits farmers' choices, excluding innovative tools not listed in government schemes.

Policy Reform: Shift to a direct benefit transfer (DBT) model for subsidies in 100% schemes, allowing farmers to purchase equipment, seeds, pesticides etc directly from the market. This would foster competition, reduce costs, and ensure access to high-quality, climate-smart technologies like precision farming tools or solar-powered irrigation systems. For example, Maharashtra's DBT pilot for micro-irrigation subsidies increased adoption rates by 25% and reduced costs by 15%, demonstrating the potential of this approach.

## Conclusion: A Policy Pivot for Sustainable Agriculture

India's agricultural policies must evolve to prioritize long-term sustainability over short-term gains. By restructuring MSP to support diverse, climate-resilient crops, reforming electricity subsidies to promote efficient water use, and transitioning to a DBT model for equipment subsidies, the government can create an enabling environment for climate-smart agriculture. These reforms, grounded in economic incentives, will empower farmers to adopt sustainable practices, ensuring food security, environmental health, and economic resilience. As India navigates the challenges of climate change, bold policy interventions are not just necessary—they are urgent. Policymakers must act swiftly to align agricultural support with the imperatives of sustainability, ensuring that the nation's farmers are equipped to thrive in a changing world.

# Food Processing Industry

## A Key Pillar of Food Security and Employment


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India is one of the largest agricultural producers in the world and is self-reliant in food grain production. Food grain production holds significant importance in the Indian economy. After the Green Revolution (in the 1970s), the use of advanced seeds, irrigation technologies, and fertilizers led to a substantial increase in food grain production in India. Since 2022–23, India has been consistently breaking records in food grain production. In 2022–23, India's food grain production was estimated at 330.5 million tonnes, which is significantly higher compared to previous years. The country produces approximately 130–135 million tonnes of rice, 112–115 million tonnes of wheat, 50–55 million tonnes of coarse grains like jowar, bajra, and maize, and 25–28 million tonnes of pulses annually. India is not only self-sufficient in food grain production but is also the world's largest exporter of rice and the second-largest producer of wheat. In recent decades, India has made remarkable progress in food grain production.

Under the Government of India's Pradhan Mantri Kisan Samman Nidhi Scheme, financial support is provided to farmers. The National Food Security Mission (NFSM) has contributed to increasing food grain production and improving crop productivity. The E-NAM (Electronic National Agriculture Market) platform offers farmers better pricing for their crops through an online mandi system. Similarly, the Green Revolution Krishonnati Scheme is known for promoting technological advancement in agriculture. Despite the impressive progress achieved due to these initiatives, a significant portion of food grains still gets wasted due to the lack of processing facilities. Post-harvest, about 5–10% of food grains are wasted due to insufficient processing. In 2023–24, India produced around 332.2 million tonnes of food grains, out of which approximately 7.4 million tonnes were wasted—around 22% of the total production. It is estimated that 10–15% of food grains are lost annually post-harvest. According to NABARD (National Bank for Agriculture and Rural Development), about 40% of fruits and vegetables are wasted each year in India. For coarse grains and pulses, the loss ranges from 6 to 8%.

India's diverse agro-climatic conditions include nearly 20 different agricultural zones, ensuring ample availability of raw materials for food processing. The country also has a large pool of scientists and researchers. Factors such as knowledge dissemination, changing lifestyles, rapid urbanization, and the increasing number of women in the workforce contribute significantly to the growing potential of the food processing industry in India. Additionally, with rising per capita income, about 50–60% of household expenditure is on food products, thereby continuously increasing the demand for processed food in India. Industries based on food processing technologies are likely to flourish in the future. While agricultural product processing in India contributes only about 7% to income, in China, it contributes 25%. India has a strong potential in the food processing sector. To promote this sector, the Ministry of Food Processing Industries under the Ministry of Agriculture has introduced several schemes.

The food processing industry in India is rapidly growing and plays a vital role in agricultural economy and rural development. It significantly contributes to GDP, employment generation, and exports. India is among the global leaders in producing agricultural commodities such as rice, wheat, milk, fruits, and vegetables. This abundance offers a strong foundation for food processing. India holds a 32% share in the global food processing market. The sector contributes about 11–12% to India's GDP. Initiatives like "Make in India" and the "PM Kisan Sampada Yojana" have boosted the food processing industry. Emphasis is being laid on mega food parks, cold storage chains, and modern technologies. Better logistics are being promoted to enhance food processing, which involves efficient collection and transportation of resources.

For the development of the food processing industry, farmers must adopt modern technologies to improve product quality and shelf life. By engaging in food processing of their own produce, farmers can significantly increase their income. Youth should actively participate in special training programs to fulfill the need for skilled labor in the industry. If challenges are addressed and resources are optimally utilized, this sector can turn India into a global food processing hub. Regional agricultural research and extension centers are organizing awareness and training programs to equip farmers, women, and youth with modern techniques. Youth are being encouraged through loans and subsidies to launch startups in food packaging and organic products.

Under the government's ODOP (One District One Product) scheme, setting up food processing units based on locally abundant crops in each district is beneficial. With surplus production, farmers can receive fair prices, and value addition becomes possible through processing.

Significant processing units for the food processing industry include coriander processing units (using cryogenic grinders to preserve aroma, nutrition, and color), garlic processing units, and edible oil processing units, among others. Garlic is considered a medicinal elixir. It contains a high amount of sulfur compounds, which gives it a strong odor. Among its components, allicin is well-known for its antibacterial properties. Garlic can be processed into various products like flakes, powder, paste, chutney, puree, and oil. The first step in processing is breaking and separating the garlic bulbs. For powder and flakes, cloves are peeled, cut, dried, and ground. For paste, the cloves are simply ground, while oil is extracted using distillation. Traditionally, cloves are separated manually or by foot pressure, which is labor-intensive and time-consuming. To address this, garlic clove separator machines have been developed, capable of separating up to 800 kg of garlic cloves per hour without damage.

Peeling garlic cloves is a difficult and time-consuming task. Traditionally, they are dried and rubbed on a sack to remove the peel. Now, machines are available for all steps—bulb breaking, peeling, peel removal, grinding, drying, and making powder or paste. Setting up a complete garlic processing unit using these machines can be highly profitable. The estimated cost for a garlic peeling machine is ₹50,000 to ₹1.5 lakh, for a dryer (solar or electric) ₹1 lakh to ₹3 lakh, for a grinding machine ₹30,000 to ₹1 lakh, and for a packaging machine ₹50,000 to ₹2 lakh. These machines can be used individually or together to set up a garlic processing unit and generate substantial economic returns.

Other potential processing units include those related to agricultural tools and seed supply, which support the food processing industry. Apart from these, many small and medium-scale food processing enterprises are active in processing local agricultural produce. Women-led self-help groups are also engaged in food processing and earning income.


PROF (DR.) P. K. SHUKLA

# India's Leadership in Climate-Smart Poultry Farming

As climate change emerges as one of the most significant global challenges of the 21st century, its impacts are being felt across all sectors of agriculture, including poultry. Rising temperatures, erratic rainfall, water scarcity, and the increasing incidence of disease have created new vulnerabilities in poultry production systems. In response, the concept of climate-smart poultry farming has gained traction globally. Among developing nations, India stands out as a leader—demonstrating innovation, resilience, and a collaborative approach in adapting its poultry sector to the realities of a changing climate.

India is the world's third-largest producer of eggs and fifth-largest producer of broiler meat, with poultry contributing significantly to rural incomes, nutrition, and employment. However, the sector is not immune to climate-induced stress. Heatwaves reduce feed intake and egg production, drought affects water and feed availability, and changing weather patterns increase the risk of disease outbreaks. Despite these challenges, India has embraced the principles of climate-smart agriculture—productivity, resilience, and low emissions—in its poultry farming systems.

One of the most notable areas where India has shown leadership is in technological innovation for climate adaptation. Across various regions, poultry farms—both large-scale and smallholder—have adopted improved housing systems to mitigate heat stress. Well-ventilated poultry houses with reflective roofing, thermal insulation, and evaporative cooling systems help maintain optimal internal temperatures even during peak summer months. These innovations are particularly critical in states such as Tamil Nadu, Andhra Pradesh, and Telangana, where summer temperatures can exceed 45°C. Automated temperature control and ventilation technologies are now increasingly integrated even in medium-scale farms, enhancing bird welfare and productivity.

India's focus on water conservation in poultry farming is another area of distinction. Recognizing the central role of water in poultry health and hygiene, farms in drought-prone regions such as Maharashtra and Rajasthan have implemented rainwater harvesting systems and drip irrigation for feed crop cultivation. These practices not only ensure year-round water availability but also reduce dependence on groundwater, aligning with broader climate sustainability goals. Furthermore, efforts are underway to recycle greywater for cleaning operations, thereby promoting circular resource use.

In terms of feeding strategies, Indian poultry researchers and nutritionists have developed climate-resilient feed formulations that are both nutritionally balanced and resource-efficient. Alternative feed materials such as rice bran, maize germ, cassava meal, and oilseed cakes are being used to reduce dependence on conventional grain-based feed, which is vulnerable to climate-related fluctuations in supply. Precision feeding techniques, including the use of automated feed dispensers, help improve feed conversion ratios, reduce wastage, and lower production costs. This not only enhances profitability but also contributes to lower greenhouse gas emissions per unit of output.

A significant component of India's climate-smart poultry strategy is the emphasis on animal health and disease management. With climate change expanding the range and incidence of diseases, India has strengthened its biosecurity protocols, especially in commercial layer and broiler farms. Regular vaccination programs, real-time disease surveillance systems, and farm-level veterinary support have become more widespread. The National Animal Disease Control Programme (NADCP) is a landmark initiative that aims to eradicate major poultry and livestock diseases through mass vaccination, providing long-term resilience to the sector.

India has also made strides in developing climate-resilient poultry breeds through selective breeding and research. Indigenous and dual-purpose breeds such as Vanaraja, Gramapriya, Kuroiler, and Kadaknath are gaining popularity among backyard poultry farmers due to their tolerance to harsh climates, resistance to diseases, and ability to thrive on local feed resources. These breeds also offer dual income through meat and egg production, making them a valuable asset for rural households in marginal environments.

One of India's unique contributions to the climate-smart poultry narrative is its integration of poultry farming with broader agroecological systems. Integrated farming systems, which combine poultry with crop cultivation or aquaculture, promote nutrient recycling, reduce external inputs, and build resilience. For example, poultry manure is increasingly being used as organic fertilizer, reducing the need for chemical inputs in crop production. In some areas, poultry-livestock-fish integration has created

closed-loop systems that maximize resource efficiency and minimize environmental impact.

India's leadership is not limited to farm-level innovations. Policy support and institutional frameworks have played a vital role in scaling up climate-smart poultry practices. The Government of India, through its National Mission on Sustainable Agriculture (NMSA) and Rashtriya Krishi Vikas Yojana (RKVY), has provided funding, technical support, and training for climate-resilient poultry initiatives. State governments, particularly in southern India, have supported farmers with subsidies for climate-resilient infrastructure and breeding stock.

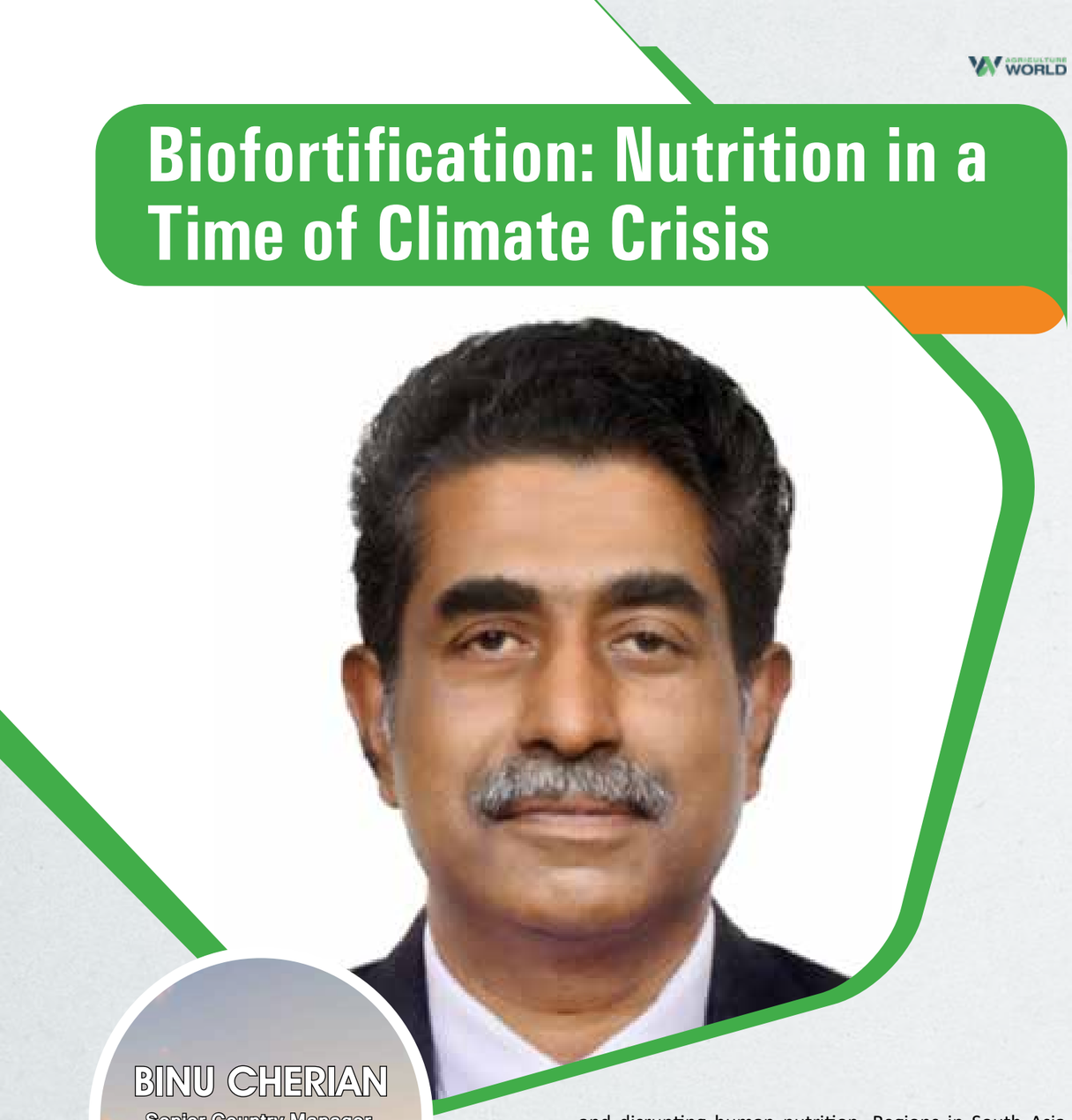
Collaboration among research institutions, the private sector, and civil society organizations has been a hallmark of India's climate-smart poultry progress. Institutions such as the Central Avian Research Institute (CARI), National Institute of Animal Nutrition and Physiology (NIANP), and several agricultural/ Veterinary universities are actively engaged in developing technologies, feed formulations, and management practices tailored to regional needs. Private poultry integrators have also invested in sustainable technologies and are supporting contract farmers in adopting best practices.

Several case studies illustrate the practical impact of India's leadership in climate-smart poultry farming. In Andhra Pradesh, a commercial broiler farm installed solar-powered exhaust fans and misting systems, which led to a 20% reduction in bird mortality during heatwaves. In rural Karnataka, tribal farmers rearing Vanaraja birds with support from a local NGO reported improved household nutrition and income, even under dryland farming conditions. In West Bengal, bio secure backyard poultry units were introduced in flood-prone districts to protect birds from disease outbreaks during the monsoon season, ensuring year-round production.

Going forward, India faces the task of scaling up these successes to reach millions of smallholder poultry farmers, many of whom remain vulnerable to climate risks. This requires continued investment in farmer education, climate services, and access to technology. There is also a need to strengthen climate finance mechanisms and develop climate-smart certification systems to encourage sustainable market linkages. As consumer demand for environmentally friendly and ethically produced poultry products grows, India is well-positioned to lead the global shift toward sustainable protein systems.

In conclusion, India's journey in climate-smart poultry farming reflects a powerful synergy between innovation, tradition, and collaboration. By embracing sustainable practices, enhancing resilience, and reducing environmental impacts, India is not only safeguarding its poultry sector against the threats of climate change but also setting a global example for sustainable livestock development. The Indian model demonstrates that climate-smart agriculture is not a luxury, but a necessity—and that with the right policies, partnerships, and innovations, it is entirely achievable.

# Biofortification: Nutrition in a Time of Climate Crisis

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Global warming is increasingly becoming a reality, with global temperatures rising approximately 1.1°C above pre-industrial levels (IPCC, 2023). Climate change will have a long-term cascading impact across food systems, particularly affecting productivity and disrupting human nutrition. Regions in South Asia and Sub-Saharan Africa are experiencing these impacts more acutely, facing rising temperatures, erratic rainfall patterns, soil degradation, and increased pest outbreaks. These challenges not only threaten crop yields, can breakdown local and regional supply chains (FAO, 2021; IPCC, 2022).

Studies have established that rising carbon dioxide ($CO_2$) levels and heat stress can reduce the concentration of key micronutrients—including zinc, iron, and protein—in major cereals like wheat, maize and rice (Myers et al., 2014; Smith & Myers, 2018). The vulnerable populations

for their daily energy needs depends on these less nutritious staples, that will make them more susceptible to micronutrient deficiencies. The disparities between climate and nutrition can threatens to deepen health inequalities that can be addressed with climate-smart, nutrition-sensitive interventions. The long-term impact of climate change can have both on supply (on farms) and demand (on consumers), leading to disruption in food systems and nutrition.

Malnutrition—particularly micronutrient deficiencies or "hidden hunger"—continues to affect over 3 billion people worldwide, especially in low-income, agriculture-dependent communities (WHO, 2020). Malnutrition is not merely a health issue—it is a development crisis. Malnutrition—particularly in early childhood—can lead to irreversible physical and cognitive impairments and trigger long-term socio-economic consequences for individuals and entire nations. (World Bank, 2020; UNICEF, 2021). In India, according to NFHS-5 (2019–21), 35.5% of children under five are stunted, and 57% of women aged 15–49 are anaemic. Biofortification emerges as a powerful and scalable agriculture solution that addresses food, nutrition insecurity and climate resilience.

Biofortification is the process of breeding crops with higher levels of essential micronutrients, such as iron, zinc, and vitamin A, while also considering traits preferred by end users, including pest resistance and tolerance to heat and drought. These enriched varieties deliver improved nutrition through the staple foods that people already grow and consume. The nutrition studies have established that biofortified crops make a measurable impact on human health when consumed daily. Unlike supplementation or industrial fortification, biofortification integrates seamlessly into existing farming and food systems, making it cost-effective, sustainable, and farmer-friendly (Bouis & Saltzman, 2017).

In Asia, about 60% of regional food is produced by smallholder farmers. Yet, they remain the most vulnerable to climate shocks. Enhancing their adaptive capacity is crucial for global food and nutrition security. This includes supporting access to biofortified and improved good quality seeds, capacity building and local advisory services, climate-resilient technologies and practices, insurance mechanisms, and inclusive markets. Climate adaptation and mitigation strategies are essential complements to biofortification. These include promoting agroecological practices, climate-resilient cropping systems, water-efficient irrigation and soil health restoration. Adoption of direct-seeded rice systems can reduce water use and greenhouse gas emissions compared to traditional transplanting methods. Integrating such strategies with biofortified crops enhances resilience, reduces vulnerability to climate shocks, and fosters long-term sustainability.

To truly benefit smallholder farmers, climate-smart agriculture (CSA) must be promoted through a multi-pronged approach. Beyond adoption at the farm level, there is also a need to create consumer-facing demand for climate-resilient practices.

Strategic actions to scale climate-smart agriculture (CSA) may be;

- Establish robust public–private partnerships (PPPs) to co-develop and scale CSA technologies and ensure efficient last-mile delivery farmers.
- Accelerate on-farm technology demonstrations and capacity building by leveraging Krishi Vigyan Kendra's (KVKs), Agri-entrepreneurs, seed companies and digital platforms to build farmer awareness and skills in adopting CSA practices.

• Enhance access to finance support and climate insurance to de-risk investments in CSA practices and inputs, particularly for marginal and women farmers.

• Strengthen value chain linkages to establish inclusive value chains.

• Improving access to high-quality seeds and establishing community seed banks help to enhance climate resilience and reduce agricultural risk.

• Community seed banks help ensure timely access to locally adapted biofortified and stress-tolerant varieties and strengthen farmers' capacity to cope with climate variability (FAO, 2015; Bioversity International, 2018).

• Incentives for farmers adopting sustainable practices related to CSA, like regenerative practices, such as conservation tillage can help in accelerating adoption.

• Establish localised climate and agromet data centres can help farmers and value chain stakeholder access the real-time data.

• Promote social equity in CSA adoption to ensure gender-responsive and inclusion approaches to address the needs and requirement of women and marginalized communities

HarvestPlus has played a pivotal role in scaling biofortification both globally and in India. Operating in over 40 countries, the program has facilitated the development and release of more than 460 biofortified crop varieties in partnership with national agricultural research systems (NARS), governments, and private sector stakeholders—reaching over 360 million people worldwide by 2024.

In India, HarvestPlus collaborates closely with NARES institutions, seed companies, and Farmer Producer Organizations (FPOs) to scale zinc-enriched wheat and rice, as well as iron-rich pearl millet. As of 2024, more than 3 million smallholder farmers in India are cultivating biofortified crops, benefiting approximately 15 million people. Additionally, the program has trained over 880,000 farmers and value chain actors to support the mainstreaming of biofortification (HarvestPlus Annual Report, 2024). Several national governments—including India, Nigeria, Zambia, and Bangladesh—have formally integrated biofortification into their nutrition, agriculture research, and food security policies (HarvestPlus Impact Report, 2023). Honourable Prime Minister of India endorsed biofortified crops for cultivation. Many biofortified varieties are not only rich in essential micronutrients but are also resilient to climate stresses, such as drought, heat, and poor soils. Some of the biofortified crops available for cultivation include iron-rich pearl millet, calcium-rich finger millet, zinc-enriched wheat and rice, iron- and zinc-rich lentils, high-iron beans, vitamin A-rich sweet potato, vit A cassava and vitamin A maize. Together, these efforts underscore the dual value of biofortified crops—delivering both nutritional impact and climate resilience—and highlight their critical role in building sustainable and future food systems that are nutritious and resilient. (HarvestPlus Annual Report, 2024).

In the face of global warming and persistent malnutrition challenges, biofortification emerges as a powerful intersection of health, agriculture, and climate change align. It equips smallholder farmers with climate-resilient crop varieties, enhances the nutritional status of vulnerable communities through essential micronutrients, and strengthens long-term food system resilience. Biofortified crops should be recognized as strategic innovations—driving progress toward a more sustainable, nutritious, and equitable future.

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# FUTURE FARMING: CLIMATE-SMART AGRICULTURE IS TRANSFORMING INDIAN AGRICULTURE


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## Introduction

India today stands at a critical juncture, facing the dual challenge of climate change and food security. Climate change is no longer a distant threat; it is a daily reality for millions of Indian farmers. Erratic monsoons, prolonged droughts, unseasonal rainfall, and extreme heatwaves are increasingly disrupting agricultural productivity and rural livelihoods. In this context, Climate-Smart Agriculture (CSA) has emerged as a science-based, practical approach to making Indian agriculture more resilient, sustainable, and adaptive to a rapidly changing climate. By aligning productivity goals with environmental stewardship, CSA offers a roadmap toward a more secure and climate-resilient agricultural future.

## What is Climate-Smart Agriculture?

Climate-Smart Agriculture is a holistic framework that integrates a range of farming practices and technologies aimed at increasing productivity, strengthening climate resilience, and reducing greenhouse gas (GHG) emissions. It is not a single technique but a context-specific set of solutions tailored to local agro-ecological and socio-economic conditions. First introduced by the Food and Agriculture Organization (FAO) of the United Nations in 2010, CSA is built on three interconnected goals:

1. **Enhancing agricultural productivity** to improve food security and rural incomes.

2. **Building resilience** to climate variability and extreme weather events.

3. **Reducing or removing greenhouse gas emissions** wherever possible.

These make CSA uniquely positioned to address interlinked challenges of agricultural development, environmental sustainability, and climate change mitigation.

## Why India Needs Climate-Smart Agriculture

India's vulnerability to climate change is deeply rooted in its agrarian economy. Over 55% of the population depends on agriculture and allied sectors for their livelihood, and nearly 60% of the cultivated land is rain-fed. These figures highlight how susceptible India's food systems are to climate disruptions.

According to the ICAR, wheat yields in India could decline by 6–23% and rice yields by up to 20% by 2050 due to rising temperatures and changing rainfall patterns. Recent climate-induced disasters viz., devastating monsoon floods in Himachal Pradesh in 2023 or the widespread drought in southern India in 2022 underscore the limitations of traditional farming systems in coping with these changes.

Ironically, while agriculture contributes about 25% of global GHG emissions, it is also one of the sectors most at risk. In India, small and marginal farmers are particularly at risk, facing not only erratic weather but also declining soil fertility and shrinking water resources.

## Core Principles and Practices of CSA in India

India's approach to CSA is multi-dimensional, focusing on practical, adaptive strategies that integrate technology, traditional knowledge, and policy support. Key CSA components in India include:

- **Climate-Resilient Crop Varieties:** Developing and promoting drought-, flood-, and heat-tolerant crop strains.
- **Water-Efficient Irrigation:** Techniques like drip and sprinkler irrigation reduce water use and increase efficiency.
- **Soil Health Management:** Practices such as organic manuring, crop rotation, and conservation tillage help restore soil fertility and carbon content.
- **Agroforestry and Diversification:** Integrating trees with crops and livestock systems boosts biodiversity and provides alternate income.
- **Climate Information Services:** Timely access to weather forecasts and agro-advisories enables better planning and risk management.

## CSA in Action: Success Stories from India

Several on-ground CSA initiatives have demonstrated the transformative potential of this approach. In Maharashtra's drought-prone Marathwada region, implementation of CSA practices including water budgeting, contour bunding, and crop diversification resulted in improved groundwater recharge and higher crop yields even during dry spells. Similarly, in Punjab, innovations like Direct Seeded Rice and the Happy Seeder technology have helped reduce water consumption and curb stubble burning, thereby lowering emissions. In Odisha, the System of Rice Intensification (SRI) method has enhanced productivity using fewer inputs, showing that low-cost innovations can yield high returns.

## Empowering Women and Marginalized Communities

CSA also presents a pathway to social equity by actively involving women and marginalized groups. Gender-sensitive extension services, microfinance initiatives, and inclusive community-led projects help ensure that climate resilience reaches those most vulnerable. Women's participation in decision-making and access to climate information tools are critical in driving long-term change at the grassroots level.

## Challenges in Scaling CSA

Despite its proven benefits, the widespread adoption of CSA faces several challenges in India:

- **Financial barriers:** High initial costs of technologies such as precision irrigation or weather stations.
- **Knowledge Gaps:** Limited awareness and technical knowledge among farmers.
- **Structural Limitations:** Fragmented landholdings that hinder large-scale implementation.

Addressing these barriers requires coordinated action involving government, research institutions, financial agencies, and civil society. Policy integration, innovative financing models, and digital platforms for information dissemination are essential to scale up CSA effectively.

## Toward a Climate-Resilient Future

Climate-Smart Agriculture represents the future of resilient, adaptive, and inclusive Indian farming. By transforming how food is grown, CSA supports food security, ecological balance, and economic stability in an era of climate uncertainty.

With the right blend of innovation, investment, and inclusive governance, CSA can help India not just adapt to climate change but lead the way in sustainable agriculture for the world.


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# Agripreneurship in India: Unlocking Rural Potential through Innovation and Enterprise

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India's agricultural sector is no longer the sole domain of traditional farmers. A new wave of innovation is sweeping across rural India, led by agripreneurs—entrepreneurs who are leveraging technology, sustainable practices and market linkages to reimagine Indian agriculture. Agripreneurship is emerging as a promising model to address food security, rural employment and climate resilience, but it also faces numerous structural and systemic challenges.

## The Rise of Agripreneurs: Transforming Challenges into Ventures

Agripreneurship involves identifying unmet needs in agriculture and developing sustainable business models to address them. These ventures span diverse sectors-agri-tech platforms, organic food brands, irrigation solutions, farm mechanization and agro-processing units.

For instance, DeHaat, founded by Shashank Kumar, is revolutionizing agri-input delivery and crop advisory by offering a full-stack digital platform to farmers across Bihar, Uttar Pradesh and Odisha. As of 2024, DeHaat supports over 1.8 million farmers and connects them to more than 10,000 agri-input retailers (AgFunder, 2024).

AgNext Technologies, based in Chandigarh, uses AI and spectral imaging to ensure quality assessment in food supply chains, reducing post-harvest losses and improving price realization for farmers.

These startups are more than profit-making entities-they are change agents filling crucial gaps in extension services, supply chains and access to markets.

## Opportunities Driving Agripreneurship

### 1. Digital Infrastructure and Government Push

With the proliferation of rural internet, mobile penetration, and digital payment systems, agripreneurs can now access remote markets and offer tech-based services. Government schemes like Agri-Infra Fund, RKVY-RAFTAAR, and Startup India offer financial incentives, infrastructure subsidies and incubation support to agri-based ventures.

The National Institute of Agricultural Extension Management (MANAGE) has trained over 85,000 agripreneurs under its Agri-Clinics and Agri-Business Centres (AC&ABC) scheme since 2002 (MANAGE, 2023).

### 2. Demand for Sustainable and Organic Products

Urban consumers are increasingly shifting towards pesticide-free, traceable food products. Startups like Zama Organics and Organic Mandya are capitalizing on this trend by offering farm-to-fork organic produce, improving both farmer incomes and consumer health.

### 3. Rise of Women and Youth in Agri-enterprise

A growing number of educated youth and women are venturing into agri-business. They are leading innovations in areas such as mushroom farming, herbal cultivation and food processing. According to a NABARD (2022) report, nearly 18% of agri-enterprises registered under MSMEs are now led by women- a positive shift in gender inclusion.

## Challenges Constraining Agripreneurial Growth

### 1. Access to Finance and Investment Risk

Despite supportive policies, many agripreneurs struggle to secure capital, especially during the initial phases.

Traditional financial institutions perceive agri-startups as high-risk due to market volatility, long gestation periods, and climate dependence.

As noted by Patel et al. (2023), "Agricultural lending in India still favours landholding-based credit, making it difficult for asset-light or service-based startups to get working capital."

### 2. Weak Market Linkages and Post-Harvest Infrastructure

A significant barrier to scaling agripreneurship is the lack of robust cold chain systems, aggregation points, and processing units. As a result, startups often incur high logistics costs or face supply inconsistencies. According to FAO estimates, India loses 30–40% of its perishable produce due to poor post-harvest management (FAO, 2021).

### 3. Digital Illiteracy Among Farmers

Although startups are digitally enabled, their primary users- farmers- often lack digital literacy. Adoption of agri-tech platforms, mobile apps, and sensor-based tools remains low in many regions, especially among elderly farmers. This slows down scale and reduces impact.

### 4. Policy Ambiguity and Regulatory Hurdles

There are multiple bottlenecks in land leasing laws, food safety norms, and inter-state agri-trade regulations. Startups also struggle with compliance to multiple authorities including FSSAI, state APMCs and pesticide regulators.

## Voices from the Field: Experts and Founders Speak

Experts unanimously believe that agripreneurs are key to making agriculture economically viable and environmentally sustainable.

"The next revolution in Indian agriculture will be led by tech-enabled entrepreneurs, not just policy makers,"

says Dr. Ashok Gulati, eminent agriculture economist and Infosys Chair Professor, ICRIER.

"We need to invest in incubation, rural digital infrastructure, and climate-resilient innovations,"

adds Prof. Ramesh Chand, Member, NITI Aayog.

"Agripreneurs are frontline innovators—they connect producers to processors, and markets to villages,"

notes Dr. Kalpana Sankar, social entrepreneur and founder of Hand in Hand India.

These perspectives highlight the need for a multi-stakeholder approach involving startups, policy makers, farmers, financial institutions, and academia.

## Towards a Resilient Agripreneurial Ecosystem

To nurture agripreneurship further, India must invest in:

- Dedicated agri-tech incubators in Tier-2 and Tier-3 cities;
- Flexible rural finance models such as agri-fintech, invoice financing, and warehousing receipts;
- Strengthening FPO-Startup partnerships to ensure grassroots reach and trust;
- Digital skilling programs for farmers to improve tech adoption;
- Policy harmonization across states to streamline regulations for food and agri-startups.

## Conclusion

Agripreneurship stands at the intersection of innovation, sustainability, and rural transformation. While the challenges are formidable, the opportunities are immense. With targeted support, inclusive innovation, and climate-smart practices, India's agripreneurs can transform agriculture into a dynamic, tech-driven, and youth-friendly sector- fulfilling the dual goal of food security and farmer prosperity.

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# Climate Smart Cotton Agriculture: Ensuring Financial Security for Smallholder Farmers and Fibre Security for India

## Introduction

Cotton is more than just a crop—it is the backbone of India's rural economy and a foundational raw material for the nation's textile industry. With over 6.5 million smallholder farmers dependent on it, and the textile sector employing 45+ million people, cotton is deeply woven into India's social and economic fabric.

As India targets USD 100 billion in textile and apparel exports by 2030, ensuring both fibre security and financial stability for farmers is essential. But this vision is challenged by climate volatility—erratic rainfall, rising temperatures, degrading soils, and increasing pest attacks have made cotton farming increasingly fragile.

At the same time, climate-conscious consumers and global brands are demanding low-carbon, traceable, and regenerative textiles. Cotton, if reimagined through a climate-smart lens, can meet both challenges—creating a resilient livelihood for farmers and a sustainable fibre base for the industry.

## The CottonGuru® Approach: From Climate Risk to Regenerative Resilience

CottonGuru Maha FPO Federation is a grassroots, farmer-led organization representing 75+ Farmer Producer Organizations (FPOs)

and over 42,000 smallholder cotton farmers across India. Our vision is to shift Indian cotton from a climate-vulnerable commodity to a climate-positive and farmer-owned fibre ecosystem.

We work at the intersection of agronomy, certification, carbon finance, market access, and social equity to build a transparent and regenerative cotton value chain.

Climate Resilient Cotton (CRC) Projects: Maharashtra and Telangana

As part of our national mission, we are leading two flagship CRC initiatives—in Yavatmal, Maharashtra and Adilabad, Telangana.

Yavatmal, Maharashtra

- 1800 tribal farmers
- 6300 acres
- 12 villages

Yavatmal, part of the drought-prone Vidarbha belt, has historically faced extreme agrarian distress. Our CRC intervention includes:

- Regenerative cotton cultivation with indigenous inputs
- 50+ Kontiki kilns to convert crop residue into enriched Biochar
- Farmer-led Pradarshan Khet™ demonstration farms

- Carbon credit registration projects with reputed brands
- Market linkage through buyback MOUs with India's top Textiles Mills
- Training for 1000+ women on sustainable farming and entrepreneurship

📍 Adilabad, Telangana

- 1500 tribal farmers
- 6000 acres
- 20 villages

In Adilabad, we are scaling a similar CRC model. Key interventions include:

- Distribution of non-GMO organic cotton seeds

- Training and Regenagri certification support

- Soil health and yield enhancement via biochar and canopy management

- Buyback commitments from premium textile brands
- Ginning infrastructure development through local FPOs


Together, these projects are building resilient, inclusive and regenerative cotton economies from the ground up.

## Collaboration is the Catalyst

A critical insight from these initiatives is this: no one can do it alone.

Whether it is a farmer trying to adapt to climate stress, a brand looking for sustainable fibre, or a startup developing biochar technology—collaboration is the missing link.

From cutting-edge material startups to mills, brands, and investors, one message is clear: the transition to low-carbon, lower-impact fashion depends on bold partnerships, aligned incentives, and co-creation.

In both Maharashtra and Telangana, we have seen how co-creation accelerates results:





- Farmers + Agronomists = practical solutions for regenerative cotton
- FPOs + Certifiers = credible traceability for brands
- Carbon platforms + rural women = monetized climate action
- Brands + buyback agreements = market stability for producers

CottonGuru® acts as the bridge between these actors, enabling each stakeholder to do what they do best—while ensuring that farmers remain at the centre of the sustainability equation.

## Impact Highlights

| Metric | Target Outcome |
|---|---|
| Increase in Soil Organic Carbon | +20% in 3 years |
| Biochar Adoption Rate | 80% of farmers in both states |
| Farmer Income Growth | +25% annually |
| Women Empowered | 2000+ trained in climate-smart practices |
| School Enrolment | 80% in target project villages |

Project impact is tracked through monthly field visits, farmer interviews, remote sensing, and mobile app-based reporting.

## Fibre That Builds a Better Future: Low Carbon Cotton™

Cotton grown under these initiatives is marketed as Low Carbon Cotton™—a brand that symbolizes:

- Organic and regenerative cultivation
- Verified carbon sequestration via biochar
- Zero stubble burning, enriched soils
- Full traceability from seed to bale

This fibre offers a triple win:

✓ Better margins for farmers

✓ Lower impact for brands

✓ Higher trust for consumers

We are in active discussions with international Brands to co-create scalable sourcing models from these clusters.

## Building the Ecosystem: From Farmer to Fashion

Through these projects, we are laying the foundation for a new cotton economy—where collaboration replaces fragmentation, and regeneration replaces extraction.

Whether it is:

- a textile brand seeking credible sustainable fibre,
- a carbon credit aggregator building farmer-level projects,
- a government body supporting climate-smart villages, or
- a mill aiming to reduce Scope 3 emissions—

we invite them to co-create with us.

## Conclusion

India's cotton belt is at a crossroads. With the right interventions, partnerships, and farmer-led models, it can become a global example of climate-smart agriculture powering sustainable industry growth.

The twin CRC projects in Yavatmal and Adilabad show that the way forward lies not in isolated innovation, but in collaborative execution. Cotton, when grown regeneratively and marketed responsibly, becomes more than just fibre—it becomes a vehicle for climate resilience, rural development, and global competitiveness.

As the textile sector accelerates toward its $100 billion goal, let's ensure the foundation is strong—with farmers who are resilient, soil that is living, and cotton that is truly sustainable.

# Gendered Impact of Climate Change in Agriculture


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## Introduction

Climate change stands as one of the most pressing global challenges of the 21st century. Its effects are far-reaching, with agriculture among the most vulnerable sectors. Within this vulnerability, a critical but often under-explored dimension is the gendered impact of climate change—how it disproportionately affects men and women engaged in agriculture due to differences in roles, access to resources, decision-making power, and adaptive capacity. Understanding and addressing these gendered nuances is essential for designing equitable, effective, and sustainable climate-resilient agricultural strategies.

## Significance of the Topic

Agriculture serves as a primary source of livelihood for a significant portion of the global population, especially in developing countries. Women make up nearly 43.0% of the agricultural labor force in developing nations, according to the Food and Agriculture Organization (FAO). Despite their critical contributions, women often have less access to land, credit, education, technology, and extension services than their male counterparts. As climate change exacerbates existing agricultural challenges—such as reduced crop yields, soil degradation, erratic rainfall, and increased incidence of pests—these gender-based disparities become more pronounced.

The gendered analysis of climate change is not only a matter of social justice but also one of economic necessity. When women farmers have equal access to productive resources, it can significantly increase agricultural output and food security. Hence, addressing gender inequalities is crucial to enhancing the resilience and sustainability of agricultural systems.

## Impact of Climate Change on Agriculture

Climate change affects agriculture in a multitude of ways:

- Changing precipitation patterns disrupt sowing and harvesting cycles.

- Extreme weather events such as droughts and floods lead to crop failure.

- Temperature increases can reduce the suitability of certain crops in traditional growing areas.

- Pests and diseases proliferate under altered climatic conditions.

These changes pose a severe threat to food security, rural livelihoods, and the overall economic stability of agrarian communities.

## Gender-Differentiated Impact of Climate Change in Agriculture

**1. Access to Resources:**

Men and women differ significantly in their access to land, finance, information, and inputs. In many regions, land titles are traditionally held by men, leaving women without collateral to secure credit. Women farmers in India own only 13.0% of the land, as joint or independent owner.

**2. Labor and Workload:**

Climate change has been linked to increased workload for women, especially in water-scarce regions. Women often engage in labor-intensive tasks, and environmental degradation makes these tasks more strenuous.

**3. Decision-Making and Voice:**

Male dominance in household and community decision-making structures limits women's participation in climate-related planning and resource allocation. Thereby, the interventions, policies and actions, do not reflect women farmer's specific concerns through these policies and interventions.

**4. Crop Choices and Food Security:**

Women are typically responsible for subsistence farming and food preparation. Climate-induced crop failures impact women more as they struggle to provide food for their families. Reduced food production results in inadequate food availability for her family, particularly the women of the households, who often have to forego their share, to feed others in the family.

**5. Migration and Social Strain:**

Climate change-induced migration is predominantly male-dominated, leaving women to manage farms and households alone without requisite support. Moreover, limited access and control over the resources of food production, adds to her challenges, with almost 'no say' in decision making.

## Women's Role in Climate Change Adaptation and Smart Agriculture

Despite the challenges, women have shown remarkable resilience and ingenuity in adapting to climate change. Smart agriculture—or Climate-Smart Agriculture (CSA)—offers a pathway to build resilience and sustainability.

Women-Led Climate Resilient Farming – Swayam Shikhshan Prayou (SSP) India

**1. Adoption of Climate-Smart Practices:**

Women have adopted agroforestry, mulching, drought-

resistant crops, and rainwater harvesting techniques. There are many examples where women have adopted climate smart technologies, to overcome its impact.

**Case Study:**

Women-Led Organic Cotton Farming – Madhya Pradesh

In the Chhindwara region of Madhya Pradesh, smallholder women farmers have embraced organic cotton farming to combat the unsustainable practices associated with genetically modified crops and chemical pesticides. Supported by organizations like the World Wildlife Fund (WWF) and Self-Reliant Initiatives through Joint Action (SRIJAN), approximately 6,000 farmers have transitioned to using natural composts and biopesticides. This shift has reduced cultivation costs, improved soil health, and preserved biodiversity by maintaining a balance between forests and agriculture. Women play a crucial role in producing and marketing organic farming inputs, enhancing their economic empowerment and leadership within the community.

**2. Community-Based Adaptation:**

Women are at the forefront of self-help groups (SHGs) and cooperatives that facilitate access to knowledge and resources.

**Case Studies**

India – Maharashtra:

In Marathwada, women-led SHGs have embraced drip irrigation and community water budgeting. WOTR has trained women in soil and water conservation, improving crop yields and reducing migration.

**3. Renewable Energy and Digital Tools:**

Solar-powered irrigation systems and mobile-based weather advisory services have empowered women in decision-making.

**Case Studies**

**Solar Sahelis – Rajasthan**

In Rajasthan, the Solar Sahelis (Solar Friends) initiative trains women entrepreneurs to market and maintain solar energy products in their communities. These women provide households with access to solar lanterns and home lighting systems, reducing dependence on kerosene and other fossil fuels. The program not




only promotes clean energy adoption but also creates income-generating opportunities for women, enhancing their social and economic status. By facilitating the use of renewable energy, the Solar Sahelis contribute to reducing greenhouse gas emissions and building climate-resilient communities.

**Policy Implications and Recommendations**

**1. Gender-Responsive Policy Frameworks:**

Climate policies must integrate gender considerations and support women-focused adaptation programs.

**2. Equal Access to Resources:**

Governments should ensure women's access to land, credit, and inputs.

**3. Capacity Building and Education:**

Training should be tailored for women using local languages and contexts.

**4. Strengthening Women's Organizations:**

Support SHGs and FPOs that include women, linking them with formal institutions.

**5. Research and Data Collection:**

Collect disaggregated data to design targeted interventions and ensure effective gender analysis.

**Conclusion**

The gendered impact of climate change in agriculture highlights the need for a more inclusive and equitable approach to climate adaptation. Women farmers are vital to the sustainability and resilience of agricultural systems. Empowering women with equal access to resources, knowledge, and decision-making is essential not just for gender equality but for the future of global agriculture.

# Agripreneurship: Opportunities and Challenges

**DR V VIJAYAN**
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## Agriculture - The Life

Agriculture is Life on Earth. Apart supplying the resources of life, it is the primary source of employment, sustenance and income generation. It weaves the fabric of rural life and underpins the economic well-being of rural communities.

Agriculture is the backbone of Indian Economy. It has contributed as high as 59% of the country's GDP in the past and still contributes to 40% of the total GDP.

More than half of the population, ~55%, is hired and engaged in the Agri sector, making it the largest employer in the world.

Despite India being the 2nd most populous country in the world, Agriculture feeds its larger population. Half of the income in the industrial sector comes from Agri industry. It still remains as the most important sector on which most of the working population depends on.

Agri business is a significant wellspring of income for both the central and state governments.





**through Biotechnology and Information Technology**

## The Rise of Agriculture

The increase in population adds more pressure on cultivable land that is almost unavailable. Only 4% addition is possible by 2050.

Traditional agriculture is insufficient to address the increasing demand of the growing population.

These prompt and compel new approaches, methods, technologies and advanced sustainable farming practices to improve and increase productivity, and reduce wastes.


Biotechnology plays a saviour role in modern agriculture by offering sustainable solutions to improve soil, conserve water, enhance crop production, improve nutritional value, improve pest and disease resistance, and promote sustainable farming practices.

Biotech offers tools to develop crops that are more resilient to environmental stresses like drought, salinity and extreme temperatures, and contributes to sustainable agriculture by reducing the environmental impact. Apart recycling agri wastes for renewable energy and cleaning up polluted agri lands and waters, Biotech also offers solutions to enhance the storage and transportation of fresh produces by increasing shelf-life and reducing spoilage.

This is crucial for adapting to the changing climate and ensuring food security.

Along with the breakthrough biotechnological advancements, the agri industry is now shifting from traditional practices to automation and data-driven management, and thereby leading to smart and precision farm practices to cope up with the dynamic earth and depleting natural resources.

Information Technology with such advancements as AI, IoT, Sensors, Weather Prediction Models, Drones and Robotics brings a new era to agriculture and compliments biotechnology in transforming the traditional farming into modern agriculture, enhancing its efficiency, productivity and sustainability while reducing the costs.

## Agripreneurship

Agripreneurship is gaining momentum as a vital component of economic development around the globe. It involves innovative agricultural practices and business strategies to enhance productivity, sustainability and profitability in the agricultural sector. This article outlines the key opportunities and challenges faced by agripreneurs today.

## Opportunities in Agripreneurship

### 1.Technological Advancements

The advent of modern technologies like drones, precision farming and data analytics offers agripreneurs the tools to optimize agricultural practices. These technologies can help in increasing yields, reducing wastes and managing resources more efficiently.

**2.Sustainable Practices**

With growing awareness and demand for sustainability, agripreneurs have the opportunity to implement eco-friendly practices. These include organic farming, renewable energy use and water conservation methods, which not only appeal to environmentally conscious consumers but also ensure long-term viability of agricultural operations.

**3.Access to New Markets**

Globalization and digital platforms have opened up new and more inter-connected world markets for agricultural products. Agripreneurs can now reach customers beyond their local regions, expanding their business horizons and boosting profitability.

**4.Government Support and Policy Initiatives**

Many governments are recognizing the importance of agriculture in economic development and are providing incentives and support to agripreneurs. These include subsidies, grants, training programs and easier access to credit facilities.

**5.Value Addition and Diversification**

Agripreneurs have the chance to add value to raw agricultural products through processing and packaging, thereby increasing their market value. Diversification into related areas like agritourism or agro-processing can also provide multiple income streams.

**6.Generating Employment Opportunities for Rural Youth**

**7.Controlling Rural Migration into Urban Areas and Alleviating Pressure on Urban Cities**

## Challenges in Agripreneurship

**1.Climate Change and Environmental Concerns**

Unpredictable weather patterns and natural disasters pose significant risks to agricultural productivity. Agripreneurs need to adopt resilient practices and technologies to mitigate these risks.

**2.Access to Finance**

Despite the availability of government support, access to finance remains a significant challenge for many agripreneurs. High interest rates, lack of collateral and bureaucratic hurdles impede their ability to secure necessary funding.

**3.Knowledge and Skill Gaps**

The transition from traditional farming to agripreneurship requires new skills and knowledge. Agripreneurs must be adept in business management, marketing and technological applications, which may require additional training and education.

**4.Market Volatility**

Fluctuations in prices of agricultural commodities affect profitability. Agripreneurs must develop strategies to manage risks associated with market volatility, such as futures contracts or diversification of products.

**5.Infrastructure and Logistics Issues**

Inadequate infrastructure, such as poor roads and lack of storage facilities, hinders the effective distribution and marketing of agricultural products. Addressing these challenges requires investment and collaboration with governmental and private sectors.

## The Future

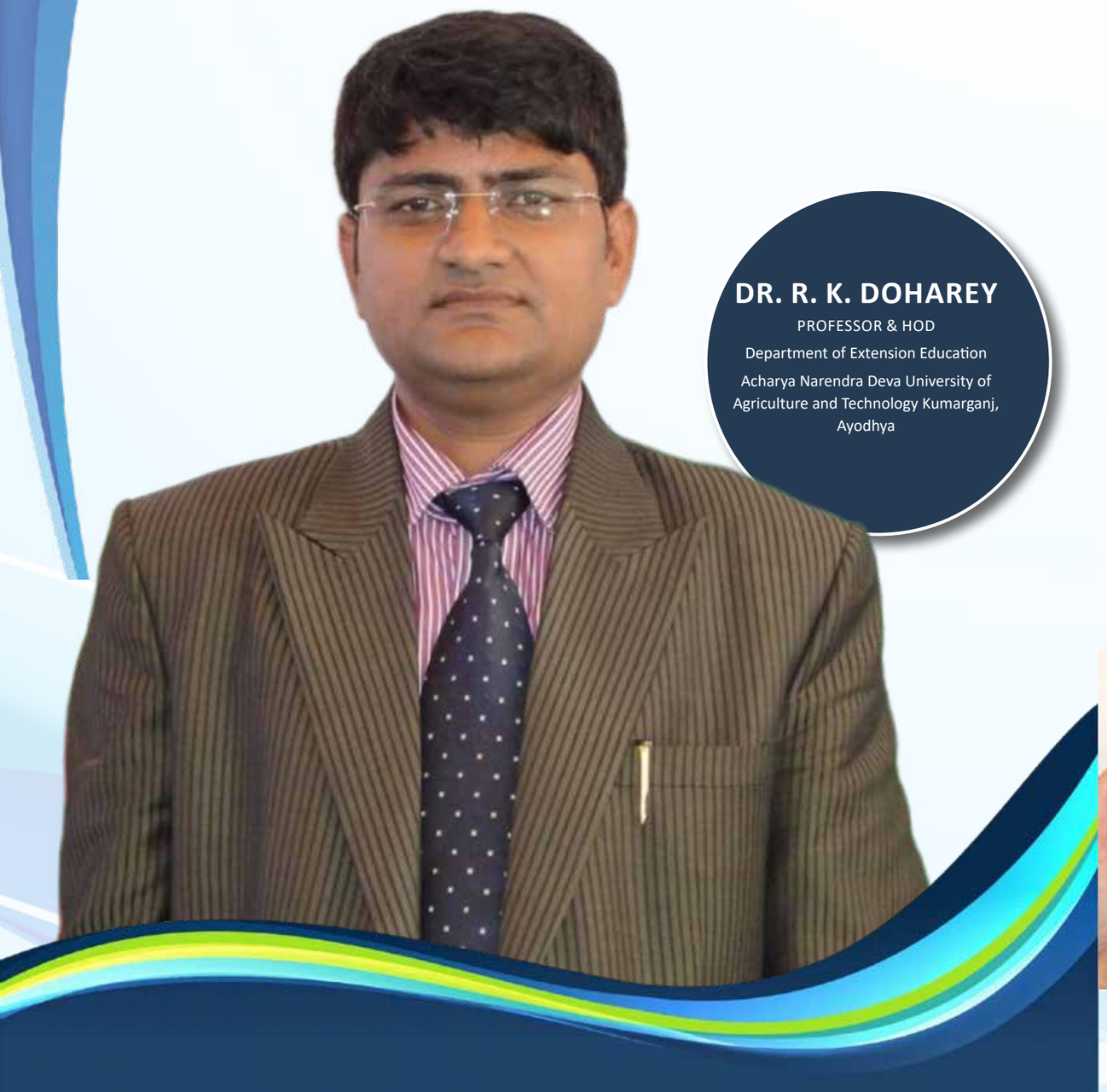
Agripreneurship holds immense potential for transforming the agricultural sector and contributing more to economic growth. By leveraging opportunities and addressing challenges, agripreneurs can play a crucial role in sustainable agricultural development. A collaborative approach involving government, private sector and educational institutions can further strengthen the agripreneurial ecosystem, paving the way for innovative solutions and a prosperous future in agriculture.

Sustainability should lie at the heart of their philosophy. They should develop and adopt eco-friendly practices that reduce carbon footprints, conserve soil and water, and promote biodiversity. They should implement crop rotation, organic farming and integrated pest management to ensure long-term soil health and ecological balance, paving the way for a more resilient future.

The future of agriculture lies in innovation and collaboration. With advancements like gene editing, robotics and blockchain, farming will become more efficient, transparent and sustainable. Agro Industries should proactively be at the forefront of this transformation, shaping the future of food production.

# *Impact of*

# Mobile Apps and Real-Time Data on Smallholder Productivity in India

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## Introduction

India's agricultural landscape is on the cusp of transformation in 2025, with smallholder farmers—those managing less than 2 hectares—at the center of a digital revolution. The rapid spread of smartphones and affordable internet, coupled with a surge in specialized mobile farming apps, is dramatically shifting how smallholders access information, manage crops, and engage with markets. This article explores how mobile apps and real-time data solutions are boosting productivity among India's 120 million+ smallholder farmers, backed by the latest data and expert insights.

## The Rise of Mobile Agriculture in India

India's rural smartphone users are projected to exceed 400 million in 2025, up from 350 million in 2023, according to the Internet and Mobile Association of India (IAMAI)[1]. Nearly 62% of Indian farmers are now using mobile apps for agricultural information, market access, and input decisions—more than doubling the estimated app usage from just five years ago[2].

## Key Developments

- **19% Growth in Farm App Downloads:** In 2024, installs of the 32 most popular Indian farming apps grew from 99 million to 118 million—a 19% jump. Leading apps such as Plantix, AgriCentral, Krishify, AgroStar, and Yara FarmCare each boast millions of users, reflecting the sector's rapid digitization[3].
- **AI and Real-Time Insights:** Over 50% of Indian farmers are expected to use AI-powered digital tools by 2025, including real-time agro-advisory features for diagnostics, fertilizer recommendations, and pest alerts[4][5].
- **Market Integration:** Over 70% of farms use mobile apps for real-time crop monitoring and management, with many accessing online marketplaces and price-trend analytics directly from their devices[5][6].

## Boosting Productivity: The Core Benefits

### Closing the Knowledge Gap

Traditional knowledge transfer in Indian agriculture faced hurdles: limited extension staff, fragmentary access, and heavy costs[7]. Mobile platforms—like Kisan Suvidha, Farmer Mobile App, and e-NAM—have democratized agricultural knowledge by:

- Delivering real-time weather forecasts, disease alerts, and agro-advisories via personalized notifications.
- Enabling illiterate or semi-literate farmers to access voice, video, or image-driven content in local languages.

A Tamil Nadu field study showed that farmers who adopted the Kisan Suvidha app improved their knowledge levels the most and achieved average yields of 61.1 quintals per hectare—compared to 57.0 q/ha (Farmer Mobile App) and 55.0 q/ha (e-NAM app)[7]. The adoption of technology translated directly to knowledge gain and productivity increases.

## Precision, Decision, and Profitability

Real-time data tools in mobile apps are pushing Indian smallholders from reactive management toward precision agriculture[1][8]:

- **Crop Diagnostics:** Apps like Plantix allow farmers to upload photos of diseased plants, instantly receive AI-driven diagnoses, and get tailored treatment advice[9][3].


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- **Input Optimization:** Real-time soil moisture, nutrient, and weather data guide farmers on exactly when and how much to irrigate or fertilize, minimizing input costs and boosting yield[5][1].
- **Yield Improvement:** Research shows precision farming using real-time data can raise yields by 10-25% and reduce input costs by 15-20% among smallholders[1][8].

Advancing Market Access and Income Security

Mobile apps are reducing smallholders' dependency on middlemen by linking them directly to buyers and market price trends:

- **e-NAM Integration:** National Agricultural Market platform apps give price forecasts, demand projections, and facilitate direct transactions[7][10].
- **Export and Market Trends:** Timely access to market intelligence enables farmers to synchronize harvest timings for peak prices, improving profitability[3][2].

Driving Adoption: Challenges and Success Stories

## Scale of Adoption

- **App Penetration:** Over 60% of Indian farmers—and more than 70% of smallholders—are expected to regularly use digital platforms for farm management by the end of 2025[5][2][6].
- **Leader Apps:** Plantix saw 30.9 million installs in 2024 (up 21% YoY), while AgriCentral, Krishify, AgroStar, and Yara FarmCare each reported user bases in the millions. Emerging apps like IFFCO BAZAR and BigHaat posted download growth of 99% and 95% respectively in just one year[3].

## Quantifying the Impact

| Metric | Before Mobile Apps | After Mobile Apps Adoption | Source |
|---|---|---|---|
| Average Cereal Yield (kg/ha) | 3,020 (2020) | 3,340 (2025 est.) | [2] |
| Smallholder Yield Improvement | — | 10%-25% | [1][8] |
| Input Cost Reduction | — | 15%-20% | [1][8] |
| Mobile App Usage by Farmers (%) | 29% (2020) | 62% (2025 est.) | [2] |
| Farm App Installs (Top 32 apps, mn) | 99 (2023) | 118 (2024) | [3] |

## Success Story: Maharashtra's Digital Leap

In Maharashtra, widespread smartphone adoption has enabled the rise of data-driven apps and digital advisory platforms. Localized advisory, soil health data, and instant

market access have helped boost yields and reduce crop losses by up to 30%. Farmers using multi-service apps—combining advisory, e-commerce, and logistics—are now able to plan, buy inputs, and sell produce entirely via their phones[11][5][3].

## Real-Time Data and the Future of Smallholder Agriculture

Mobile apps and real-time agricultural data are transforming India's farm sector by:

- **Empowering Smallholders:** Farmers gain the ability to shift from intuition-based to science-driven decisions, levelling the playing field with larger producers[10][1].
- **Climate Resilience:** Real-time weather, pest, and disease alerts enable smarter irrigation, sowing, and protection strategies, reducing vulnerability to climate shocks[5][1].
- **Market Transparency and Profit:** Farmers have more negotiating power and can time sales more effectively, increasing profitability and price realization[9][3][2].



By 2025, over 70% of Indian farmers are expected to use digital platforms, ensuring that the benefits of technology-driven agriculture reach even the most remote villages[5][6].

## Conclusion

The digital transformation in Indian agriculture, led by mobile apps and real-time data solutions, is a game-changer for smallholder productivity. Significant improvements in yield, input use, market access, and income are driving the widespread adoption of agricultural mobile apps. As India accelerates its journey toward food security and rural prosperity, the empowering force of mobile technology is poised to be the single most impactful lever for millions of smallholder farmers.

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# Changing Dynamics of Herbal & Medicinal Farming in India

## 1. Introduction

India's rich heritage of herbal medicine is deeply rooted in systems like Ayurveda, Siddha, and Unani. With approximately 15,000 medicinal plant species—of which about 3,000 are actively used in codified systems—India ranks second only to China in medicinal plant diversity.

This biodiversity is supported by India's diverse ecosystems, ranging from cold deserts to tropical rainforests, accounting for nearly 7% of the world's biodiversity. Medicinal herbs are used extensively in pharmaceuticals, cosmetics, wellness products, and increasingly in the food and beverage industry—such as herbal teas, supplements, and functional foods.

Globally, the herbal market is valued at USD 72 billion and is projected to reach USD 7 trillion by 2050 with a CAGR of 14.88%. Europe leads with a USD 7.5 billion market, especially in Germany and France. In India, the herbal product market is expected to grow from USD 60.52 billion in 2023 to USD 110.08 billion by 2032, driven by rising awareness, demand for natural products, and policy support.


**DR ISHAN YADAV**

Head - Business Operations
HNCO INFUSIONS PRIVATE LIMITED


## 2. Evolution of Herbal Farming in India

The dynamics of herbal and medicinal farming have evolved alongside human civilization—rooted in ancient traditions, shaped by socio-economic shifts, and now accelerating rapidly with modern science, global demand, and sustainability imperatives.

**Historical Evolution** | **Current Scenario and Market Landscape** | **Future with emerging trends**

### 2.1 Traditional Practices and Their Challenges

#### 2.1.1 Sourcing and Farming

Earlier, medicinal farming in India was largely unorganized. Farmers lacked access to Good Agricultural Practices (GAP), quality planting materials, or structured cultivation guidelines. Most herbs were sourced from forests—about 80–90%—often harvested destructively, pushing many species toward extinction.

#### 2.1.2 Priority and Research

Post-independence, government and research priorities focused on food crops like wheat and rice, leading to forest degradation and reduced attention to medicinal plants. This compromised India's wild herb population and conservation efforts.

#### 2.1.3 Quality and Market

The lack of traceability led to adulteration, misidentification, and inconsistency in active ingredients—resulting in poor-quality herbal raw materials. Farmers also had limited access to organized markets or post-harvest knowledge.

### 2.2 Structural Shift toward Cultivated Farming

Structural transformation started from wild collection and scattered traditional practices to more organized, commercially cultivated farming systems. This shift has been driven by a mix of socio-economic, technological, and policy-level factors, paving the way for better quality control, traceability, and scalability. Below are the key drivers and impacts of this transition:

#### 2.2.1 Socio-Economic Factors

Rising incomes, digital access, health consciousness, and awareness have led consumers to choose chemical-free, herbal alternatives. Herbal products are no longer niche but part of everyday routines.

#### 2.2.2 Globalization & Export Opportunity

The global acceptance of Ayurveda and plant-based wellness has made Indian herbs sought-after exports. This demand encourages quality-driven, bulk cultivation of select species.

#### 2.2.3 Government & Institutional Support

The National Medicinal Plants Board (NMPB) offers up to 75% subsidies for endangered species and supports organic cultivation through schemes like Paramparagat Krishi Vikas Yojana (PKVY) and Atmanirbhar Bharat.

#### 2.2.4 Technological Advancements

Adoption of WHO-GAP and GACP standards, chemical fingerprinting, pesticide regulation, and contaminant testing have improved traceability and certification of herbal raw materials.

#### 2.2.5 Industry-Led Cultivation

Demand from herbal extract manufacturers, exporters, and direct-to-consumer brands has fueled organized farming. Aloe vera (Ghritkumari), now seeing annual demand of 15,700 MT, has overtaken traditional species like Amla.

#### 2.2.6 Sectoral Impact

This structural transformation promises:

- Reduced reliance on forests and biodiversity conservation
- Improved farmer incomes through structured value chains
- Export-ready, standardized herbal products

## 3. Future with Strategy for way forward

### 3.1 Wild Resource Conservation

Many Himalayan and forest species are nearing extinction.

Strategy: Launch a long-term national program for in-situ conservation and sustainable utilization.

### 3.2 Commercial Cultivation Expansion

Despite progress, local cultivation faces challenges in planting material, anchor institutions, and subsidy access.

Strategy: National quality planting material program, Support to farmer clusters and community organizations and Simplify subsidy delivery

### 3.3 Post-Harvest Infrastructure

Poor post-harvest handling causes major losses.

Strategy: Set up regional centers for drying, grading, storage, and testing through govt intervention or inviting FPO, SSG's and NGO's

### 3.4 Fair Trade & Transparency

The sector lacks traceability, leading to authenticity and price discovery issues.

Strategy: Develop trade records and chain-of-custody protocols, Train local authorities in identification and source tracking

### 3.5 Research & Development Coordination

Fragmented R&D has slowed progress in resolving controversial drugs and preserving germplasm.

Strategy: Establish National and Regional Raw Drug Repositories, Coordinate efforts through a nodal agency and Publish quinquennial demand-supply reports

### 3.6 Policy & Regulation Reform

Multiple regulations across states create confusion.

Strategy: Formulate a unified National Medicinal Plant Policy, Harmonize Forest Transit Rules and review Biodiversity Act provisions, and Upgrade botanical coding in foreign trade (ITC-HS)

### 3.7 Capacity Building

Training and awareness among stakeholders are critical.

Strategy: Publish a compendium of 1,178 traded species, Create stakeholder-specific training modules, and Disseminate audiovisual material on harvesting and post-harvest best practices

### 3.8 Strengthening Institutional Mechanisms

NMPB needs greater technical capacity.

Strategy: Establish Medicinal Plant Technical Support Groups (MP-TSGs), Launch a web-based national portal for reporting and compliance and Reinforce NMPB's operational infrastructure

## 4. Conclusion

The dynamics of herbal and medicinal farming in India are rapidly evolving. With rising global demand, improved consumer awareness, and government push for sustainable practices, the sector stands at a strategic crossroads. From unorganized wild collection to technology-backed, policy-supported cultivation, the herbal industry reflects a blend of tradition and innovation. Challenges remain standardization, traceability, and capacity building, but the roadmap is clear. By investing in conservation, cultivation, quality control, and market linkage, India can emerge as a global leader in herbal products benefiting farmers, ecosystems, and health-conscious consumers around the world.

# Agriculture Today, India - Climate-Smart Agriculture: Adapting to a Changing Environment

Agriculture stands at a defining crossroads. On one side lies the traditional way of farming, deeply rooted in generational practices. On the other, a new reality shaped by erratic climate patterns, soil degradation, water scarcity, and volatile markets is forcing us to rethink how we grow, manage, and trade food.

The growing unpredictability of the environment is no longer a temporary disruption—it's the new normal. And this change demands a strategic response. At FarmERP, we believe Climate-Smart Agriculture (CSA) is not only the future of farming but also a critical driver of agri-business resilience and economic sustainability.

## Understanding the Need: The Impact of Climate Change on Global Agriculture

The global agriculture sector, contributing nearly 24% of global greenhouse gas emissions (IPCC), is both a victim and a contributor to climate change. Rising temperatures, shifting rainfall patterns, and frequent extreme weather events are threatening crop yields, livestock productivity, and input resource efficiency.

The World Bank estimates that climate change could reduce crop yields by up to 30% by 2050 in some regions if no adaptation strategies are implemented. Developing economies, especially in Asia and Sub-Saharan Africa, are at greater risk due to a heavy reliance on agriculture for livelihoods and GDP contribution.

This creates a complex paradox: agriculture must feed a growing population, reduce its environmental footprint, and become more resilient to climate volatility—all at once.

## What is Climate-Smart Agriculture (CSA)?

CSA is a strategic approach to agricultural development that seeks to:

**1. Increase productivity and income** sustainably.

**2. Enhance resilience** (adaptation to climate change).

**3. Reduce greenhouse gas emissions,** where possible.

However, CSA is not a one-size-fits-all model. It requires a localized, tech-enabled, and data-driven approach that accounts for climate, crop type, geography, and business goals.

## Market Landscape and Adoption Trends

The global CSA market is expected to reach **USD 18.7 billion by 2030,** growing at a CAGR of 12–15%, driven by:

- **Sustainability mandates** from global buyers and regulatory bodies.
- A surge in **impact investments** in agri-climate technologies.
- **Digitization of farming practices** and supply chains.
- Integration of **satellite, IoT, and AI-driven analytics** in large farms and agribusinesses.

Governments in countries like India, the UAE, Kenya, and Brazil are launching subsidies and frameworks to support CSA at both policy and grassroots levels. For private sector players, CSA is rapidly moving from a "nice-to-have" to a **core strategic imperative.**

## How FarmERP Enables Climate-Smart Agriculture

As a pioneer in digitally transforming agribusiness, FarmERP has worked with large-scale producers, exporters, food processors, and contract farming organizations across 30+ countries. We have successfully partnered with one of the well-known brands for carbon credit project and AI powered climate smart advisory to organic cotton farmers.

Our CSA-enabling framework is built on five key pillars:

## 1. Climate Risk Intelligence and Predictive Analytics

Using APIs that ingest weather, climate, and satellite data, FarmERP provides predictive models for:

- Rainfall and drought patterns
- Crop disease outbreaks
- Soil health variations
- Stress zone detection (via NDVI)

This empowers enterprises to make data-backed decisions—from sowing and irrigation planning to harvest timing and workforce mobilization.

## 2. Precision Resource Management

In regions like the Middle East and Maharashtra, our clients use IoT sensors and FarmERP's irrigation scheduling module to reduce water usage by 30–40%. Our platform supports:

- Variable rate irrigation and fertilization
- Efficient pest and nutrient management
- Energy-efficient equipment tracking

By optimizing input use, agribusinesses achieve cost savings and emission reductions, which are essential in climate-vulnerable zones.

## 3. Carbon Accounting and ESG Reporting

FarmERP's carbon accounting module enables businesses to monitor:

- Fertilizer-derived emissions
- Scope 1 and Scope 2 energy use
- Chemical usage and residue levels

These capabilities help enterprises generate ESG reports, meet compliance for EU Green Deal standards, and qualify for carbon credits or sustainability-linked financing.

## 4. Climate-Linked Insurance and Traceability

Through our traceability engine, enterprises can:

- Map field activities to quality outcomes
- Establish full product journey for export compliance
- Support index-based crop insurance schemes

When combined with remote sensing and risk assessment, this creates a safety net for farmers and improves investor confidence in agri-projects.

## 5. Capacity Building and Digital Access

We recognize that technology is only as good as its adoption. Our mobile-first interface, multilingual support, and partnership with agri-extension bodies ensure that climate-smart insights are accessible to farmers and field agents—not just the boardroom.

We've implemented farmer registration and training modules across Africa and India, enabling knowledge transfer on CSA techniques.

## The Business Case for CSA

Integrating climate-smart practices is not just about impact—it's about profitability, competitiveness, and long-term viability. Agribusinesses that invest in CSA are already witnessing:

- **10–15% higher yields**
- **Improved supply chain reliability**
- **Access to sustainability-oriented buyers**
- **Reduced post-harvest losses**
- **Greater appeal to green investors and carbon markets**

CSA is fast becoming a differentiator in B2B negotiations—particularly in exports, food processing, and retail sourcing.

**MR. SANJAY BORKAR**
CEO & Co-Founder, FarmERP

# Climate Smart Agriculture: Adapting to a Changing Environment with focus on Soil Health

As the world grapples with the consequences of climate change, agriculture intrinsically tied to natural cycles is at the forefront of both vulnerability and solution. In India, where agriculture sustains nearly half the population, the stakes are particularly high. Climate-smart agriculture (CSA) offers a roadmap to ensure food security while fostering resilience and reducing greenhouse gas emissions. Central to CSA's success is soil health a critical yet often overlooked component of sustainable farming. This article explores role of soil health in adapting to climate change and transforming Indian agriculture.

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## The climate and soil context in Agriculture

India's agricultural landscape is diverse, ranging from the arid and less endowed regions to the fertile Indo-Gangetic plains. However, this diversity is increasingly under threat. Unpredictable rainfall, prolonged droughts and extreme weather events have become frequent, disrupting farming practices. Crop yields are stagnant or declining, pest outbreaks are rising and the livelihoods of smallholder farmers, who form the backbone of Indian agriculture, are increasingly at risk.

Soil degradation further exacerbates the problem. Continuous mono-cropping, excessive use of chemical fertilizers and poor water management have depleted soil nutrients and reduced organic matter. According to a report (1) by the Indian Council of Agricultural Research (ICAR), nearly 30% of India's soils are degraded. Without intervention, the nation faces the twin challenge of feeding its increasing population and safeguarding the environment.

## What is Climate Smart Agriculture?

Climate-smart agriculture (CSA) is an approach that helps guide actions to transform agri-food systems towards green and climate resilient practices. (#FAO) By focusing on sustainable practices and innovative technologies, CSA emphasizes long-term environmental health while addressing the immediate needs of farmers. At the heart of this strategy lies soil health which is a dynamic and living system that is fundamental to plant growth and climate regulation.

## The Vital Role of Soil Health

Healthy soil acts as the cornerstone of CSA, playing a pivotal role in achieving its goals:

**1. Nutrient Cycling and Productivity:** Soils rich in organic matter enhance nutrient availability for crops, reducing dependence on chemical inputs.

**2. Carbon Sequestration:** Soils act as a major carbon sink, storing more carbon than the atmosphere and vegetation combined. Practices that enhance soil organic matter eg cover cropping help mitigate climate change by sequestering carbon.

**3. Water Retention and Erosion Control:** Healthy soils with good structure can retain more water of great importance in drought-prone regions. They also resist erosion, protecting valuable topsoil from being washed away during heavy rains.

**4. Biodiversity and Ecosystem Services:** A thriving soil micro biome supports nutrient cycling, pest control and disease resistance.

## Climate Smart Practices to Improve Soil Health

Transitioning to CSA involves adopting practices that restore and maintain soil health. In India the ground level interventions that are making a difference are briefly explained:

1. The recently launched National Mission on Natural Farming (2) is aimed towards improving soil health and reducing input cost to the farmer to achieve greater climate resilience.

2. The **Paramparagat Krishi Vikas Yojana** promotes organic farming, while **National Mission for Sustainable Agriculture** focuses on soil health management & conservation agriculture.

3. The **Soil Health Card Scheme** provides farmers with soil nutrient status and tailored fertilizer recommendations. The implementation needs to be strengthened through regular follow-up and localized advisory services.

4. **Bio Input Resource Centre** under the National Mission on Natural Farming aims to establish 10000 BRCs. These centres will support the local production and availability of bio-inputs for natural farming, promoting chemical-free farming practices.

5. **Pre Monsoon Dry Sowing** (PMDS) (3) is being practiced extensively in Andhra Pradesh under the AP Natural Farming project and becoming popular with farmers.

6. **Farm lab model** developed by Dr SK Chavan is helping farmers especially in Maharashtra to produce and multiply bio-inputs (4) at farm level. This intervention presented to Hon'able Prime Minister is being upscaled to establish 1140 farm labs in line with BRC approach by Maharashtra government.

7. **Microbial consortia Jeevamrit** (5) developed by Dr VK Sachan, Deputy Director, Agriculture, UP is becoming popular with farmers due to its ingenuity and simplicity.

8. Emerging technologies such as biochar, which improves soil carbon storage and microbial inoculants boost soil fertility, hold promise for the future.

9. The Indian bio-input market, comprising of biofertilizers, biopesticides and biostimulants currently valued at Rs.7100 crores is growing rapidly due to increasing demand for eco-friendly agricultural practices and supportive government policies will contribute significantly to climate smart agriculture. This is also referred as the BioAgri Revolution (6) by PUSA-Krishi

Technology plays a transformative role in CSA and monitoring soil heath. Digital tools integrated with soil sensors, satellite imagery and mobile apps help farmers and stakeholders including the government to monitor soil health and make data-driven decisions. Various apps are providing real-time information on weather, soil conditions and crop advisories. While CSA offers immense potential, several challenges e.g. limited awareness, resource constraints need to be addressed through multi-stakeholder collaborations involving governments, NGOs, private players and farmer's organizations. Awareness and capacity building activities and programs, demonstrations and financial incentives can accelerate the adoption of CSA and restore soil health.

## Conclusion

The symbiotic relationship between soil health and climate-smart agriculture presents a golden opportunity for India to transform its agricultural sector and move towards Viksit Bharat by 2047. By nurturing the soil the food security for future generations, resilience against climate change and reduced environmental footprints can be ensured. For India, the adoption of CSA is not just a necessity but an ethical imperative. Investing in soil health today will yield dividends in food security, farmer and nation prosperity and ecological balance tomorrow. As the saying goes, "Take care of the soil and the soil will take care of us." It's time to sow the seeds of change for adapting to a changing environment.

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# World Youth Skills Day: Pathbreaker Pinki Kumari shows how skill-based training can spark hope in rural India

According to a NITI Aayog report, women-led micro-enterprises account for only 20 per cent of all MSMEs in India. This isn't due to a lack of ambition, but rather the absence of accessible credit, supportive policies, and key business services such as financial advice, technology, and marketing. In Jharkhand's Fadilmarcha village (Ranchi district), Pinki Kumari has written a triumphant story of resilience despite the above-mentioned odds. A graduate living with her husband and in-laws, for years Pinki watched helplessly as her family struggled with financial hardship while surviving on a meagre annual income of just Rs 2.45 lakhs. With limited access to technology, information and government support, their farming practices were stuck in a cycle of loss and uncertainty.

Things started to change when Pinki was identified as an aspirational farmer under Transform Rural India's (TRI) Millionaire Farmers Development Programme (MFDP). Through training, exposure visits, and hands-on learning, she adopted practices like drip irrigation, grafting, mulching, and protected cultivation. Today, she cultivates over 2.5 acres of land and has increased her income to

**Youth-oriented rural initiatives are also helping to break gender barriers for women like Pinki**

Rs 13.24 lakhs a year, growing tomatoes, strawberries, cauliflower, and watermelon. She also contributed to the creation of a Farmer Field School in her village, and now guides others to transcend their challenges like she did.

Pinki Kumari's aspirational journey can bring hope to countless young women in rural India who also want to build their own ventures and achieve economic independence. Like her, they too can benefit from structured training under programmes like the MFDP which has set up Village Development Committees (VDCs) to identify local talent. The programme offers technical training, exposure to tested models, and guidance on modern farming methods.

Pinki's success came from training that matched her local conditions. Along with updated agricultural techniques, she received support to cultivate grafted vegetables and practice intercropping, such as cauliflower with ginger. "These techniques helped me grow more, reduce losses, and make better use of my land. I also began cultivating high-value crops like strawberries and capsicum using protected methods, something new in my village," says Pinki. These changes improved her own yields and turned her farm into a demonstration site for others.

The MFDP has also transformed the lens through which rural youth view farming. Once considered an unpredictable and poorly paid last option, it is now seen by many as an empowering pursuit. Catalysts like Pinki are changing perspectives as well. "Known locally as 'Pinki Didi,' she is now respected by young people as a trailblazer. Her success has shown that farming can be profitable with modern methods, diverse cropping, and a smart use of technology," says Bapi Gorai, Senior practitioner, TRI

Pinki's success also points to the importance of addressing gender barriers in youth-focused programmes. In a setting where women were usually kept out of leadership roles, she leased land independently, managed multiple crops, and trained both men and women. Her transition from a farmer's wife to a local trainer shows that women can become key drivers of change when their innate skills are respected and nurtured.

**P RAJAN MATHEWS**
Chief Brand Mentor, PRO NEXT FOOD BRANDS.

# Engaging with Farmer Producer Groups (FPOs)

Engaging with Farmer Producer Groups (FPOs) involves building collaborative relationships with these groups, empowering them, and facilitating their growth. FPOs are organizations of farmers who work together to improve their livelihoods through collective action.

Engaging effectively with Farmer Producer Groups (FPOs) requires a strategic and empathetic approach that acknowledges their unique challenges and aspirations. It begins with fostering trust and open communication, ensuring FPOs feel heard and supported. Tailoring initiatives to their specific needs, such as providing training on sustainable practices or offering guidance on financial literacy, can significantly enhance their capabilities.

Furthermore, leveraging technology can play a pivotal role in empowering FPOs. Introducing digital tools for market analysis, inventory management, and real-time collaboration can enable members to streamline their operations and make informed decisions. Encouraging peer-to-peer learning and establishing mentorship networks can also amplify their growth by allowing FPOs to share experiences and learn from one another.

Lastly, creating platforms for dialogue between FPOs, policymakers, and stakeholders can lead to better advocacy for their interests, ensuring a collective voice influences policies that impact them. By envisioning FPOs as active agents of change, rather than beneficiaries, the agricultural ecosystem can unlock their potential to innovate and thrive, driving a more resilient and equitable future for farming communities.




### Strategic Interventions in Building FPOs:

**Promoting Sustainable Practices:** Encouraging FPOs to adopt environmentally friendly and sustainable farming practices is essential for long-term resilience. This involves educating members on organic farming techniques, water conservation methods, and integrated pest management, while fostering a culture that values ecological preservation.

**Building Business Models:** Helping FPOs develop viable and sustainable business models is pivotal to their growth. This includes guiding them in financial planning, diversifying their income streams, and adopting cooperative structures. Sustainable business models ensure the longevity of FPOs by balancing profitability with social responsibility.

**Integrating FPOs to the Food Processing Industry:** Assisting FPOs in finding and connecting with appropriate markets for their products, both locally and internationally, empowers them to unlock their economic potential. This can be achieved through partnerships with trade organizations, leveraging e-commerce platforms, and facilitating participation in global agricultural fairs. Market linkages enhance visibility, drive revenue growth, and create opportunities for rural development.

Integrating Farmer Producer Organizations (FPOs) with the packaged food industry offers significant benefits for both, including increased farmer income, access to new markets, and a more robust supply chain for the industry. FPOs can provide a reliable source of quality produce for food processing companies, while the industry can offer value addition, processing, and marketing opportunities for FPOs, leading to a more sustainable and profitable ecosystem.

### Benefits for FPOs:

- **Increased income:** FPOs can negotiate better prices for their produce by aggregating it and selling in bulk, reducing reliance on intermediaries and ensuring fair market prices,
- **Access to new markets:** FPOs can connect with retailers, supermarkets, and exporters, expanding their market reach and reducing dependence on local markets.
- **Value addition and branding:** FPOs can engage in processing, packaging, and branding of their produce, creating higher-value products and enhancing their market value.
- **Reduced post-harvest losses:** By integrating with the food processing industry, FPOs can minimize spoilage and waste by selling their produce to companies that can process and preserve it.
- **Improved bargaining power:** Collective bargaining through FPOs provides farmers with a stronger voice in the market, enabling them to negotiate better terms with buyers.
- **Access to technology and knowledge:** FPOs can leverage the expertise of food processing companies to adopt new technologies and improve their farming practices.
- **Financial assistance:** Government schemes and financial institutions provide support for FPOs to establish processing and storage facilities.

### Benefits for the Packaged Food Industry:

- **Reliable source of quality produce:** FPOs can provide a consistent supply of raw materials, ensuring the quality and availability of produce for food processing.
- **Reduced procurement costs:** By working directly with FPOs, food processing companies can reduce their procurement costs and eliminate intermediaries.
- **Strengthened supply chain:** FPOs can help create a more resilient and transparent supply chain, reducing risks and improving efficiency.
- **Access to diverse produce:** FPOs can provide access to a wider variety of crops and produce, allowing food companies to expand their product offerings.
- **Support for rural development:** Collaborating with FPOs can contribute to the economic development of rural communities and promote sustainable agriculture.

Strengthening these partnerships requires prioritizing trust, transparency, and shared goals. Collaborative efforts


can include capacity-building programs, financial support, and technology transfer tailored to the needs of FPOs. By integrating farmers' voices in decision-making processes and addressing structural challenges, these relationships can foster innovation and equity. Together, stakeholders and FPOs can pave the way for transformative change in the agricultural landscape, ensuring that small-scale farmers actively shape the future of sustainable farming while accessing the resources and opportunities they deserve.

# Climate Smart Agriculture:

# Adapting to Changing Environment – The Potential for India


SANDEEP SABHARWAL

Co-Founder, Sajeevan Life Pvt Ltd.


In a landmark statement, Hon'ble Vice President of India recently emphasized a vital shift in focus — from "food security" to "farmers' prosperity." This signals a timely and much-needed transformation in how we view and support Indian agriculture, especially considering the stark realities faced by India's farming community. As per the National Sample Agriculture Survey 2024, 44% of farmers own less than 1 acre of land, and 33% hold between 1 and 2.5 acres — cumulatively accounting for 77% of Indian farmers falling into the "marginal farmer" category. This demographic is the most vulnerable to climate change and economic instability, yet holds the key to India's agricultural and environmental resilience.

## Understanding Climate Smart Agriculture (CSA)

Climate Smart Agriculture (CSA) is not merely a buzzword. It is a comprehensive strategy aimed at transforming and reorienting agricultural development under the new realities of climate change. The threefold goals of CSA — increased productivity, enhanced resilience, and reduced greenhouse gas emissions — perfectly align with the needs of India's marginal farmers.

For these farmers, CSA offers low-cost, high-impact practices: organic agroforestry, crop diversification, reduced chemical input, and improved water management. These methods lower input costs, reduce soil and water degradation, and support better yields — not just in terms of output, but in terms of nutritional quality and resilience to erratic weather patterns.

## Realities of Income in Sustainable Farming

However, the economic returns from sustainable interventions are often modest, especially in the short term. For instance, a farmer practicing organic agroforestry on 2.5 acres may earn just INR 2000–3500 annually from carbon credits — modest by any standard and certainly not sufficient to transform livelihoods. This limited income potential highlights an essential truth: CSA alone cannot ensure prosperity. It must be part of a broader, integrated economic model for rural transformation.

## The Untapped Ecosystem of Rural Wealth

Where, then, will the prosperity come from? The answer lies in expanding the definition of agriculture itself — beyond crops and cattle — into an interconnected ecosystem of opportunities. India's $6 lakh crore of annual farm gate produce waste is a glaring challenge, but also a goldmine waiting for innovation.

Here are eight critical sectors that, if aligned with climate-smart principles, can become engines of rural employment and wealth creation:

**1. Water Resource Innovation:** From micro-irrigation to groundwater recharge, decentralized water management technologies can generate employment while ensuring water resilience.

**2. Green Farm Inputs Production:** Rural enterprises producing biofertilizers, organic stimulants, indigenous seeds, and bio-pesticides can create a circular economy and replace expensive imports.

**3. Green Energy:** Decentralized ethanol, compressed biogas (CBG), and solar-based cold chains are not just climate-smart — they are enterprise-smart, offering high returns and low entry barriers.

**4. Soil Health Services:** A largely overlooked employment opportunity, soil testing, composting, and soil organic carbon management can become mainstream rural livelihoods under a national soil health mission.

**5. Food Processing and Value Addition:** Dehydration units, pulping facilities, and rural micro-food enterprises can minimize post-harvest losses while creating micro-market linkages and jobs.

**6. Agri Equipment and Tool Manufacturing:** Reviving the rural hardware sector — from hoes to harvesters — through skill development and cooperative-based manufacturing units.

**7. Agri-Tech and Mechanization:** Custom Hiring Centres (CHCs) offering rental models for tractors, drones, and other smart tech democratize access and reduce operational costs for smallholders.

**8. Logistics and Infrastructure:** Micro cold storage, pack houses, rural transportation networks, and farm-level warehousing can plug the infrastructure gap that bleeds value from Indian agriculture.

## Investing in Climate Smart Agriculture: The Missing Link

While the vision is compelling, the implementation bottleneck remains — where is the investment for all of this together?

One route is foreign direct investment (FDI), intelligently deployed in collaborative models where farmers are treated as equal stakeholders. For example, carbon markets, agroforestry ventures, and food processing industries can offer profit-sharing agreements that prioritize farm-level incomes.

The other — more powerful and enduring — route is through farmers' cooperative institutions. India is already laying the foundation with Farmer Producer Organizations (FPOs), Dairy and Agro Cooperatives, and Self-Help Group (SHG) clusters. With appropriate financial literacy, decentralized governance, and access to credit and technology, these grassroots institutions can manage the entire value chain — from production to processing to marketing.

A cooperative-driven model also counters the fragmented and often predatory approach of MNC-dominated agri-businesses, which frequently focus on single interventions without a holistic view of the farmer's well-being.

## Climate Smart + Cooperative Smart = $5 Trillion Potential

The convergence of climate-smart strategies and cooperative-led entrepreneurship presents a historic opportunity. With India's existing agri-GDP hovering around $500 billion, the transformation of agriculture and allied sectors into a $5 trillion economy within five years is not a pipe dream — it is a pragmatic possibility.

This transformation will require:

- **A national climate-agriculture employment mission** to scale CSA-linked rural enterprises.
- **Blended finance models** — combining public schemes, private capital, and CSR — focused on long-term returns rather than short-term profits.
- **Localized innovation hubs** to adapt technologies to the diverse agro-climatic zones and social contexts of rural India.
- **Smart governance** that enables decentralized execution with real-time data monitoring, accountability, and capacity building.

## A Tough Road to Certain Prosperity

India stands at the cusp of a green revolution 2.0 — not one based on chemicals and hybrid seeds, but on ecological intelligence, rural enterprise, and institutional empowerment. Climate Smart Agriculture is the entry point, but prosperity lies in stitching together a wider vision that includes infrastructure, finance, innovation, and inclusive governance.

The question is no longer whether India can adapt to climate change — the question is whether India can lead the world in building a prosperous, resilient, climate-smart rural economy. The answer depends on how fast we integrate these ideas and scale them — not in isolation, but as a unified national mission.

The time to act is now.

# Exemplifying Holistic Village Development

What is development? There are many answers to this question. In the words of Edgar Owens, a world-renowned author, "Development is when people develop, not things." This perspective emphasizes that true progress lies in empowering people rather than merely building infrastructure. Development should enhance people's capabilities, enabling them to sustain and improve their lives while fostering resilience within communities.

S M Sehgal Foundation embraces this people-centered approach by designing and implementing development initiatives that are sustainable in the long run. A project is considered sustainable when it strengthens a community's ability to cope with challenges, enhances its resources and skills, and continues to yield benefits without depleting natural resources. Sustainability in rural development is not just about maintaining physical assets like check dams, ponds, agricultural machinery, schools, or irrigation systems. It also involves building human and social capital by providing communities with access to information, awareness, skills, problem-solving abilities, and collaboration opportunities. This asset-capability approach ensures that development is not only socially and economically viable but also environmentally responsible.

A fundamental step in fostering sustainable development is the formation of community-based institutions, such as Village Development Committees (VDCs), women's groups, or water management committees. These institutions serve as platforms for communities to articulate their needs, participate in planning, and lead initiatives in collaboration with local governance structures like gram panchayats. To guide grassroots practitioners in fostering sustainability, the VCCS model—Village Development Committee, Capacity Development, Convergence, and Sustainability—offers a structured pathway. This model has helped communities take ownership of initiatives by working in synergy with local institutions, ensuring that the benefits endure for generations. However, in areas where social capital is weak, the process requires more time and effort.

This approach was successfully implemented in the HDFC Parivartan Project in Chhata, Mathura, where VDCs were established across 15 villages. These committees, inclusive of all societal groups, played a pivotal role in driving participatory development and ensuring the long-term sustainability of the project's interventions.

Khursi village, located in Chhata Block of Mathura District, Uttar Pradesh, was like many rural villages in India—a patriarchal society primarily dependent on traditional agricultural practices. The village faced multiple socio-economic challenges.

When the S M Sehgal Foundation began its intervention in Khursi, the community was sceptical, having experienced setbacks in development work in the past. To bridge this trust deficit, the team organized inclusive community meetings, ensuring representation from different wards and various castes. This effort laid the foundation for a VDC, a platform to facilitate community-led development. The committee consisted of twenty-six members, including ten women—a significant shift in a village where women's presence in public forums like the Chaupal was almost non-existent. Through continuous training and capacity-building sessions, the VDC began to assert its role in village development, marking a turning point for Khursi, particularly in the empowerment of women. The village had a population of approximately 950 households, with a majority engaged in agrarian livelihoods. While only a few households could be classified as Above Poverty Level (APL), most households in the village faced economic hardships.

One of the VDC's first initiatives was to install solar street lights across the village. Before this intervention, the village plunged into darkness after sunset, making mobility difficult and raising security concerns, especially for women and children. The installation of solar lights not only brightened the village pathways but also instilled a newfound sense of safety and confidence among the villagers. While site selection for the lights initially posed challenges, the active engagement and consensus-building efforts of the VDC members helped resolve the issue efficiently.

Agriculture, the backbone of the village economy, had remained unchanged for generations, relying on traditional techniques and manual labour. Before the intervention, only twelve farmers possessed essential farming tools such as harrows, cultivators, seed drills, and cotton sowing machines. To modernize farming practices and improve productivity, an Agri-Tool Operators Group (ATOG) was formed in June 2024, with seven members. The introduction of modern equipment like zero-till drills, tractor-mounted sprayers, and power weeders on a rental basis at subsidized rates significantly reduced labour dependency and costs. Previously, spraying pesticides on an acre of farmland required nearly four hours of labour for Rs 500. With the tractor-mounted sprayer, the same task was completed in just an hour at Rs 2500. Similarly, power weeders slashed costs from Rs 2400 per acre to Rs 1200 per acre, cutting working hours by more than half. As a result, twenty-eight farmers benefited from these modern techniques, covering fifty-nine acres and generating substantial savings while improving efficiency. The earnings from ATOG rentals amounted to Rs 27,675, with a small portion reserved for equipment maintenance.

Beyond mechanization, the intervention also encouraged farmers to diversify their crops. Traditionally, cotton, mustard, and wheat dominated the fields, while vegetable farming was rare due to saline water conditions and a lack of awareness. Farmer Field Schools and training sessions introduced innovative practices that made vegetable cultivation viable. One progressive farmer, Neeraj, decided to experiment with tomatoes and peas, transforming his income potential. While he previously earned Rs 40,000 per acre from cotton cultivation, his earnings surged to Rs 1,00,000 per acre by switching to vegetables. Encouraged by his success, several farmers followed suit, leading to an expansion of vegetable farming to eight acres, marking a significant departure from conventional crop patterns.

Education was another critical area that saw a remarkable transformation. The village school, once plagued by inadequate infrastructure, underwent significant improvements facilitated by the VDC. The introduction of smart classrooms, a drinking water station, sanitation units, a science lab, and a library enhanced the learning environment. Additionally, the Building as Learning Aid (BaLA) paintings were introduced to make classroom walls interactive and engaging. These efforts contributed to improved learning outcomes, reduced dropout rates, and increased enthusiasm for education among children. As a result, seventy students, including thirty-nine girls, benefited from these educational advancements, paving the way for a brighter future.

The livelihood opportunities for women also expanded through targeted interventions. The VDC initiated a livestock distribution program, empowering marginalized families to achieve economic stability. Surekha, one of the beneficiaries, received four does and a buck, which multiplied over time, significantly increasing her earnings. From having limited income opportunities, she was able to generate eighty-five thousand rupees through livestock sales. To support this initiative, village women were trained as Gram Sakhis, equipping them with veterinary knowledge to ensure better livestock


health and productivity. These efforts not only improved household incomes but also reinforced women's participation in economic activities.

The VDC's role extended beyond agriculture and livelihoods, successfully bridging the gap between villagers and government welfare schemes. Ms. Anju Singh, a VDC member, played a crucial role in facilitating applications for various government programs, ensuring that over twelve hundred farmers received PM-KISAN benefits. Additionally, she assisted in securing LPG connections under the Ujjwala Yojana and helped elderly villagers enrol in pension schemes, further improving the community's overall well-being. The increasing involvement of women in governance and decision-making marked a profound shift in the village's socio-political fabric.

The transformation of Khursi village embodies the essence of self-reliant and sustainable rural development. Through collective action, the community has reduced its dependency on external resources, improved its agricultural practices, strengthened local governance, and enhanced socio-economic conditions. This journey of empowerment and progress aligns closely with Mahatma Gandhi's vision of Village Swaraj—a self-sufficient and resilient rural society. From better agricultural productivity to improved education and greater gender inclusivity, Khursi now stands as a model of community-driven transformation, showcasing the power of participatory development and local leadership.

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# India's French Fry Industry is Surging - but Talent is Lagging Behind

MR. SOUNDARARADJANE
CEO, HyFarm, HyFun Foods.

India's frozen French fry sector is booming, but a severe talent gap threatens its growth. From breeders to cold chain engineers, the industry urgently needs skilled professionals to power a people-led rural transformation.

India is sprinting up the global leaderboard in frozen French fry production. Harvesting over 60 million tonnes of potatoes a year, it's already the world's second-largest potato grower. Frozen fry consumption is accelerating at 15–20% CAGR, propelled by QSR expansion, modern retail, and exports. Plants, lines, and cold stores are rising fast across Gujarat, Punjab, Uttar Pradesh and beyond.

### What isn't rising fast enough? People.

"We've got the acreage. We've got the manufacturing plants. We've got the demand," says **Soundararadjane, CEO, HyFarm, HyFun Foods.** "What we don't yet have is enough talent. We urgently need a new generation of professionals in agronomy, soil science, pathology, engineering, cold storage, digital agriculture, and farmer engagement."

This is bigger than fries. It's a rural economy play built on quality, traceability, and sustainability—and it needs skilled leaders across the chain.

### Growth Snapshot

- #2 potato producer globally
- 15–20% annual growth in frozen fry consumption
- Rapid build-out of cold chains and automated processing
- Exports climbing as tuber specs match global QSR standards
- Seed-to-shelf investment is strong — but the talent pipeline is weak

### Where the Gaps Are Deepest

### 1. Breeders & Seed Scientists

Processing-grade fries start with varieties that combine high dry matter, low reducing sugars, disease resistance, and climate resilience.

Gap: India still relies on a narrow set of varieties not fully optimised for local soils or long storage.

### What's needed:

- India-adapted, climate-resilient processing varieties
- Resistance stacking against late blight, PVY, etc.
- Multi-location trials to pick regional champions
- Fast-track multiplication via processor–FPO–seed firm collaboration
- Molecular tools and rigorous field checks to maintain purity

Strategic urgency: Broaden the varietal base or risk bottlenecks in quality and storage.

### 2. Agronomists for Seed Multiplication & Commercial Production

**Seed Multiplication Agronomists**

- Manage isolation, rouging, virus indexing, certification
- Support pre-basic seed via tissue culture/aeroponics
- Preserve varietal integrity with breeder interfaces

**Commercial Production Agronomists**

- Fine-tune spacing, irrigation, nutrition for processing specs
- Maximise dry matter, size uniformity, skin finish
- Match harvest timing to factory intake windows

**Gap:** Plenty of "general" agronomy, but scarce processing-grade expertise — leading to rejections and losses.

### 3. Soil Scientists & Plant Pathologists

**Soil Scientists**

- Conduct plot-level profiling (texture, pH, K, microbiome)
- Prescribe amendments to hit dry-matter targets
- Advocate sustainable rotations in contract zones

**Plant Pathologists**

- Build early-warning systems for late blight, PVY, bacterial wilt
- Embed IPM, clean seed, and certification protocols

**Gap:** Too few field-ready scientists integrating diagnostics with commercial outcomes — raising rejection and storage risk.

### 4. Cold Chain & Mechanisation Engineers

**Cold Chain Engineers**

- Design CIPC-free storage compliant with new regulations
- Use sensors to control temperature, $CO_2$, humidity — curbing sugar buildup
- Integrate remote monitoring and automation

**Farm Mechanisation Engineers**

- Deploy precision planters, smart harvesters, grading/sorting systems
- Mechanise clusters where labour is tight

Bottom line: Tuber-specific engineering is non-negotiable for scale and consistency.

### 5. Digital Agri-Tech Experts

- Satellite/remote sensing for acreage, vigour, harvest timing
- AI advisories for irrigation, fertigation, disease risk
- Big-data platforms integrating inputs, weather, pests, yield, quality
- End-to-end traceability via IoT, QR codes, blockchain

**Opportunity:** Digitising seed-to-fry flows boosts efficiency and trust.

### 6. Quality Assurance & Food Safety Technologists

- Lab and in-line testing for dry matter, sugars, colour, texture
- Microbial/chemical compliance for domestic/export markets
- Manage audits (FSSC 22000, HACCP, ISO 22000)

**Gap:** Few QA pros understand potato/frozen specifics; firefighting replaces prevention.

### 7. Farmer Cluster Managers & Extension Agents

- Organise farmers into traceable, digitally managed clusters
- Execute digital contracts — inputs, pricing, delivery
- Push mobile advisories, QR-coded batches, real-time logistics

**Gap:** Paper, spreadsheets, and fragmented chats dominate. Professional rural managers can fix that.

### 8. Crop Physiologists – Climate-Smart Production Specialists

- Develop protocols for heat, drought, and canopy stress management
- Screen and recommend climate-resilient, water- and nutrient-efficient varieties
- Optimise WUE/NUE and align sowing–harvest windows with shifting seasons
- Strengthen post-harvest resilience by reducing sugar buildup and storage losses
- Lead multi-location adaptation trials with breeders and pathologists

**Gap:** Very few crop physiologists work within commercial potato chains, leaving climate stress impacts under-addressed—driving higher rejection rates, volatile storage outcomes, and rising supply risks.

### A National Talent Agenda

To convert momentum into dominance, investment must pivot from machines to minds:

- Launch potato-specific curricula in agri, engineering, and tech institutes
- Set up processing-focused talent hubs in key belts
- Offer internships, certifications, and fellowships for field-intensive roles
- Forge public–private training partnerships in digital ag, cold chain, and processing agronomy

“The next big leap in Indian agriculture will not be crop-driven. It will be talent-driven.” – Soundararadjane

### Conclusion: A People-Powered Fry Revolution

India’s French fry story is no fast-food fad; it’s a rural transformation play blending crop science, engineering, data, and export economics. Infrastructure alone won’t unlock it. The sector is ready for lift-off — it’s time for future leaders to step in and steer.

# Cultivating Resilience: Climate-Smart Agriculture in India

**SUMIT TEWARI**
**Agriculturist, Secretary and Co-founder of Bangla Susthayi Krishi Foundation**

## Abstract

Indian agriculture is highly vulnerable to climate variability, as roughly half of the farmland depends on uncertain monsoons and contributes around 40% of national food output (Ministry of Agriculture, 2022). Climate-smart agriculture (CSA) is an approach that simultaneously seeks to increase productivity, enhance resilience, and reduce greenhouse-gas emissions (FAO, 2013). This paper reviews India's climate risks and surveys CSA strategies – from precision irrigation and improved crop varieties to traditional practices (e.g., millet cultivation, water-harvesting structures) – that have shown promise in mitigating those risks (ICAR, 2023). The analysis underscores that mainstreaming CSA across India's diverse agroecosystems is essential for sustainable food security and farmer livelihoods (MoEFCC, 2021).

## Introduction

"You cannot change the climate, but you can change the way you farm."

— M.S. Swaminathan, Father of India's Green Revolution

Indian farmers face mounting climate pressures. Heatwaves, floods, and droughts have become more frequent in the last few decades (MoEFCC, 2021). The number of extreme rainfall and drought events nearly tripled between 1950 and 2015 (ICAR, 2023). About 55% of India's net sown area is rain-fed, yet it contributes around 40% of the total food production, making it highly sensitive to climate variability (Ministry of Agriculture, 2022).

In this changing context, CSA offers a path to sustain yields, protect farmer incomes, and promote environmental resilience (FAO, 2013). The strategy focuses on strengthening agriculture to deal with uncertainty, variability, and long-term climate shifts (FAO, 2013).

## What is Climate-Smart Agriculture?

CSA is not a single solution but a set of approaches that aim to achieve three outcomes simultaneously: improving productivity, enhancing resilience, and reducing greenhouse gas emissions (FAO, 2013). The concept is context-specific and adaptable to various agro-climatic zones (ICAR, 2023).

For instance, while a drought-prone region might focus on water-conserving crops and irrigation, flood-prone areas may adopt water-resilient crop varieties and drainage management (MoEFCC, 2021). The FAO defines CSA as an approach that "sustainably increases productivity, enhances resilience, reduces greenhouse gases, and achieves national food security and development goals" (FAO, 2013).

## Why India Needs CSA Now

India's agricultural sector is highly climate-sensitive, and regions like Bundelkhand have already seen major crop shifts due to prolonged droughts (Ministry of Agriculture, 2022). Farmers in that region have moved from water-intensive rice and wheat to millets, which are more climate-resilient (ICAR, 2023).

Overall, if adaptation measures are not taken, studies estimate that crop yields could fall by 4.5% to 9% by 2030 (ICAR, 2023). These figures are not hypothetical—they are based on ongoing patterns in rainfall decline, increasing temperature, and reduced soil moisture content (MoEFCC, 2021).

## Key Pillars of Climate-Smart Agriculture

### 1. Productivity Enhancement

One objective of CSA is to improve yields while conserving natural resources (FAO, 2013). Precision agriculture tools like soil-moisture sensors, remote-sensing, and crop advisory apps help optimize water and fertilizer use (NABARD, 2021).

In Maharashtra's Jalna district, sugarcane farmers using drip irrigation reported a 35% reduction in water use with no compromise in yield (NABARD, 2021). Similarly, weather-based advisory services have enabled timely decision-making for sowing, irrigation, and harvesting (Ministry of Agriculture, 2022).

### 2. Adaptation and Resilience Building

Resilience-focused CSA practices include crop diversification, agroforestry, conservation tillage, and climate-resilient crop varieties (IRRI, 2020). In Odisha, short-duration, submergence-tolerant rice varieties like Swarna Sub1 have helped farmers replant crops quickly after floods (IRRI, 2020).

The System of Rice Intensification (SRI), implemented by farmers in Tamil Nadu, improved paddy yields by over 30% while reducing water input by nearly half (IRRI, 2020). Traditional water conservation structures like Johads in Rajasthan and Ahar-Pyne in Bihar offer models of decentralized climate adaptation (MoEFCC, 2021).

### 3. Emission Reduction and Mitigation

Agriculture contributes approximately 17.6% of India's total greenhouse gas emissions, mainly from rice cultivation and livestock (MoEFCC, 2021). Practices such as alternate wetting and drying (AWD) in rice farming can reduce methane emissions by up to 48% (MoEFCC, 2021).

Similarly, optimized fertilizer application, improved livestock feed, and bio-digestion of animal waste can significantly cut nitrous oxide and methane emissions

(MoEFCC, 2021). The Soil Health Card scheme helps farmers manage nutrient use and reduce over-application of synthetic fertilizers (PIB, 2022).

## Indigenous Knowledge and Innovation Synergy

Many traditional farming systems in India already embody the principles of CSA (Ministry of Agriculture, 2022). The revival of millet cultivation, especially in dryland regions, illustrates how indigenous practices offer robust climate solutions (ICAR, 2023).

In Bihar, community-based water systems like Ahar-Pyne help maintain groundwater recharge even during poor monsoon years (MoEFCC, 2021). Similarly, tribal farming systems in Central India that use mixed cropping and agroforestry offer built-in buffers against climatic fluctuations (ICAR, 2023).

## Policy Framework and Institutional Support

India's policy push for CSA began with the National Mission on Sustainable Agriculture (NMSA) under the National Action Plan on Climate Change (NAPCC) (MoEFCC, 2021). Initiatives such as the Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) and the Soil Health Card scheme have significantly improved irrigation efficiency and nutrient management (PIB, 2022).

Public-private partnerships, Krishi Vigyan Kendras (KVKs), and programs like the National Innovations on Climate Resilient Agriculture (NICRA) have piloted and scaled CSA practices across various regions (ICAR, 2023). These programs emphasize knowledge sharing, farmer training, and access to credit (NABARD, 2021).

## Barriers to Adoption

CSA practices are promising but face real-world constraints. Many small and marginal farmers lack awareness, capital, or technical support to adopt them (Ministry of Agriculture, 2022). High initial investment, such as for drip systems or solar pumps, often deters adoption (NABARD, 2021).

Further, lack of access to insurance, poor market linkages for non-traditional crops like millets, and insufficient training are other limiting factors (PIB, 2022). These challenges are especially pronounced in tribal and remote regions where institutional reach is limited (ICAR, 2023).

## The Road Ahead

To make CSA more widespread, India must expand its outreach and support systems (MoEFCC, 2021). Extension services should be strengthened, especially digital advisories in vernacular languages (Ministry of Agriculture, 2022). Crop insurance schemes need to be made more accessible and tailored to climate risks (NABARD, 2021).

Incentives for biodiversity-friendly practices, subsidies for climate-resilient seeds, and platforms for farmer-to-farmer knowledge sharing can significantly improve adoption (PIB, 2022). Climate-resilient agriculture should not be an option—it must be integrated into the core strategy for sustainable development (FAO, 2013).

## Conclusion

Climate-smart agriculture represents more than a set of technologies—it is a transformational approach to rebuild Indian agriculture in the face of climate change (ICAR, 2023). It fuses science and tradition, empowering farmers to become proactive managers of their agro-ecosystems (FAO, 2013).

As Indian climate activist Sunita Narain rightly said, "We need to go back to the future. What was sustainable in the past must guide us today." Empowering farmers with CSA tools is not just a policy imperative—it is a national necessity (MoEFCC, 2021). The time to act is now, before the next flood, the next drought, the next lost harvest (ICAR, 2023).


# Indian Farmers on a New Path of Self-Reliance!

India's soul resides in its villages, and at the heart of those villages are the farmers. Since independence, India has made remarkable strides toward self-reliance in the agriculture sector. The Green Revolution made us self-sufficient in food grain production, but now the time has come to further modernize agriculture to truly empower our farmers.

August 15, Independence Day, reminds us that self-reliance is not just vital for the nation but equally crucial for every farmer. In today's era, where challenges like climate change and rising input costs are mounting, it's essential that farmers adopt solutions that help them achieve higher productivity at lower costs and complete farming activities on time.

In this direction, agricultural mechanization plays a key role, and companies like STIHL are providing farmers with tools that assist them on this journey. These tools not only save time and labor but also make farming more efficient and profitable, enabling farmers to become truly self-reliant.

## Mechanization in Agriculture: Path to Farmer Self-Reliance

Today, the use of modern agricultural machinery is rapidly increasing across the Indian farming sector, marking a crucial step toward self-reliance. These machines help farmers perform more work in less time, reduce costs, and earn better profits. This not only eases agricultural tasks but also ensures timely plowing, sowing, and harvesting—critical for good crop yields.

## STIHL Power Weeder: Simplifying Soil Preparation

Farming begins with proper soil preparation, which includes tasks like plowing, weeding, and levelling- often labor-intensive and time-consuming. STIHL's powerful Power Weeder models speed up these processes while saving time and effort. With this machine, farmers can now easily perform heavy-duty tasks, leading to healthier and more productive crops, bringing them one step closer to self-reliance.

## STIHL Brush Cutter: Effective in Weed Control and Crop Harvesting

Weed control is a major challenge in farming, as it directly affects yield. Likewise, harvesting crops like wheat, rice, and others is a labor-intensive task. STIHL's Brush Cutter offers an excellent solution to both issues. This machine not only helps farmers effectively control weeds but also supports efficient crop harvesting, empowering them on their journey to self-reliance.

## STIHL Water Pumps: Solving Irrigation Challenges

Water is the most crucial element in farming and often poses a significant challenge. STIHL's water pumps- WP 300, WP 600, and WP 900- offer a practical solution. These pumps are specially designed to transport water efficiently from one location to another. Farmers can draw water from rivers, ponds, lakes, or wells and directly channel it into their fields.

The greatest advantage of these pumps is that they run on petrol, freeing farmers from dependence on electricity. This means even in remote villages or hilly terrains with limited power access, these pumps can be used with ease. This flexibility allows timely irrigation anytime and anywhere, ensuring optimal crop health and yield.

## STIHL Mistblowers: Crop Protection and Efficient Spraying

Protecting crops from pests and diseases is a crucial part of farming, and timely pesticide spraying is essential. STIHL has introduced a reliable range of petrol-powered mistblowers that make spraying operations more effective. Models like SR 420, SR 450, and SR 5600 are specifically designed for fruits, vegetables, and grape cultivation. These mistblowers simplify spraying across large fields and reduce both labor and cost by doing more work in less time.

## Easy Maintenance and Service Support: Another Pillar of Self-Reliance

For farmers, purchasing agricultural equipment is important, but so is its maintenance and timely servicing. STIHL doesn't just sell products—it provides necessary accessories like spare parts and offers training and usage guidance. This ensures farmers get the most from their tools and enjoy long-term reliability.

STIHL's widespread network of dealers and service centers across India ensures prompt assistance to farmers whenever needed. This easy access to service and support gives farmers the confidence and independence to tackle any issue—reinforcing their journey toward self-reliance.

## STIHL: A Global Name, Trusted by Farmers

Founded in 1926, STIHL is a German company and one of the world's leading outdoor power equipment manufacturers. In India, STIHL has been actively serving farmers for over 20 years, building a strong nationwide presence. With its commitment to quality, durability, and innovation, STIHL has earned the trust of farmers, gardeners, construction professionals, and forestry workers globally.

The company boasts over 120 importers, 55,000 authorized dealers, and 44 owned sales subsidiaries, reflecting its global reach and robust service network.

With fresh thinking and a new approach, STIHL is reaching farmers directly through dealers and representatives. Through on-field demonstrations, farmers are provided with practical knowledge about product usage and benefits—making them more productive, aware, and self-reliant. In this way, STIHL is not only simplifying agricultural work but also playing a vital role in driving transformation across India's farming community.

## For More Information:

If you are a farmer aspiring for self-reliance and considering purchasing STIHL's agricultural equipment, visit the official website at: https://www.stihl.in/en

You can also call or send a WhatsApp message to 9028411222 for assistance.

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