



SUSTAINABLE AGRICULTURE DEVELOPMENT

KURUKSHETRA (JULY 2023)



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• DEHRADUN • GANDHINAGAR • KANPUR • PATNA • RAIPUR • RAJKOT • RANCHI • SURAT • VADODARA
Whatsapp No. 93132-18734, 82877-76460 (contact@chahalacademy.com)



What is the importance of Agriculture in India?

Agriculture is one of the main sectors driving the Indian economy. The importance of the sector is clear from the agriculture industry's contribution to employment and GDP (Gross domestic product) in India's economy. Sustainable agricultural practices are required for Indian agriculture to be profitable in the long run. In fact, despite the long-term trend in the country's favour towards urbanisation, two-thirds of the population in India still depends on agriculture for a living in rural areas. A variety of reforms, plans, projects, and policies have been put into place by the government with the goal of increasing farmer incomes, fostering sustainable agriculture, and fostering farmer prosperity.



Technologies for Sustainable Agriculture Development

- **Agriculture** is the backbone of the Indian economy, **employing more than half of the country's population**.
- India's traditional agricultural methods are frequently unsustainable and have a severe impact on both the environment and public health. Therefore, to ensure agriculture's long-term viability in India, sustainable agricultural practices are essential.
- The World Bank estimates that **42.1% of Indians were employed in agriculture** as of the year **2020**.
- 54.4% of the workforce is employed by the industry and services sectors, which together account for more than 80% of the nation's gross value added.
- The fact that 45.6% of the workforce is still employed in agriculture, which accounted for 18.29% of GVA in 2019–20, shows that a sizeable section of the Indian population depends on it for their living.
- However, as the nation's economy has evolved and other sectors, like services and manufacturing, have grown, such as the percentage of the population employed in agriculture has gradually decreased over time.
- With 60.5% of the population working in agriculture in 2000, there has been a noticeable trend away from agriculture in recent years.
- Even though the agriculture sector's share of India's per capita GDP has decreased over time, it still plays a crucial role in the economy in terms of employment and means of livelihood.
- The government has started a number of programmes to encourage the growth of the agriculture industry, such as the Pradhan Mantri Fasal Bima Yojana, the Pradhan Mantri Krishi Sinchayee Yojana, and the National Agriculture Market (e-NAM) platform.
- The Pradhan Mantri Fasal Bima Yojana (PMFBY) is a groundbreaking policy that offers farmers a comprehensive risk solution at the lowest uniform premium across the nation, reports the survey. The PMFBY receives over 5.5 crore farmer applications each year.

What is Sustainable Agriculture?

- Sustainable agriculture is a farming method that considers the soil, the environment, and the community's long-term health. It is critical to meet rising food demand while protecting natural resources for future generations.
- As the world has become more aware of the importance of environmental preservation, sustainable agriculture has received significant attention in recent years.
- Sustainable agriculture produces food, fibre, or other plant or animal products while preserving the environment, public health, human communities, and animal welfare. Natural resources such as soil, water, and air are conserved and regenerated for future generations through these practices.
- As a developing country, India is vital in achieving sustainable agriculture globally. Agriculture provides a living for more than 58% of India's population. One of the most significant challenges confronting Indian farmers is declining soil fertility due to the excessive use of chemical fertilizers, pesticides, and intensive farming practices. Adopting

Gross Domestic Product (GDP) Growth Rate in India

- Per capita GDP estimates the average economic output per person in a specific country or region.
- The agricultural sector's contribution to per capita GDP in India has decreased over time.
- The Ministry of Statistics and Programme Implementation (MoSPI) forecasts that the GVA of agricultural and allied sectors was 20.2% in 2020-21, 19.8% in 2021-22, and 18.3% in 2022-23.

sustainable agriculture practices in India is critical for the long-term sustainability of the agriculture sector.

- The Indian Government and various organisations have launched several initiatives to promote sustainable agriculture practices. E.g., National Food Security Mission, Pradhan Mantri Fasal Bima Yojana, and Soil Health Card Scheme.
- Adopting technologies can be crucial in developing sustainable farming systems that promote environmental, social, and economic sustainability.

Role of Technology in Developing Sustainable Agriculture

- **Precision Farming:** It involves sensors, GPS mapping, and data analytics to monitor and optimise crop performance. By using precision farming techniques, farmers can reduce the use of fertilisers and pesticides, improve water management, and increase yields.
- **Agroforestry:** It is a land-use integrated management system that combines trees and shrubs with crops and livestock to create a more sustainable and productive farming system and helps in soil conservation, biodiversity conservation and carbon sequestration.
- **Vertical Farming:** It cultivates crops in stacked layers, under controlled conditions which helps increase local food production while reducing water conservation and optimise resource utilisation.
- **Hydroponics:** It involves growing plants in nutrient-rich water without soil. This approach can allow for year-round crop production.
- **Renewable Energy-based:** Renewable energy can be used to power farming operations. This approach can reduce greenhouse gas emissions and dependence on fossil fuels.
- **Robotics and Automation-based:** These can help reduce labour costs, improve crop yields.

Gaps Identified in Adopting Sustainable Agriculture Development

- **Lack of Awareness and Knowledge:** Many farmers are unaware of the advantages of sustainable agriculture or how to efficiently implement it.
- **Limited Access to Finance:** Significant infrastructure and technological expenditures are needed for sustainable agriculture. For small-scale and marginal farmers, this is difficult.
- **Inadequate Policy and Regulatory**

Framework: The regulatory framework in India and its policies do not always encourage the adoption of sustainable agricultural practices. For example, only 0.8% of the Ministry of Agriculture and Farmers Welfare's (MoAFW) budget goes to the National Mission for Sustainable Agriculture.

- **Limited Research and Development:** More study and work are required to develop sustainable agricultural methods that are suitable for India.
- **Lack of Infrastructure and Technical Support:** The Indian agriculture industry has considerable obstacles due to a lack of infrastructure, including cold chains, storage facilities, and rural roadways.
- **Low Productivity:** India's agriculture is known for its low productivity. Many factors, including low levels of mechanisation, insufficient irrigation infrastructure, and poor soil health, lead to India's yield per hectare being much lower than the global average.
- **Fragmented Landholdings:** Because the average landholding size is small, adopting modern farming techniques becomes difficult at times.
- **Lack of market access:** Small and marginal farmers in India are compelled to sell their products at cheap prices to middlemen because they are unable to access direct markets. As a result, farmers earn less money and consumers pay more for food.
- **Inadequate Infrastructure:** The agriculture sector in India has considerable obstacles due to inadequate infrastructure, including rural roads, storage facilities, and cold chains. This makes it challenging for farmers to deliver their goods to marketplaces, safely store it, and then sell it.
- **Climate Change:** Climate change poses significant challenges in terms of water availability, pest and disease management, and crop yields.
 - The changing weather patterns, including erratic rainfall and rising temperatures, affect crop productivity and increase farmers' vulnerability.

Govt. initiatives to encourage sustainable agricultural practices

- Paramparagat Krishi Vikas Yojana
- Soil Health Card Scheme
- Rashtriya Krishi Vikas Yojana
- Pradhan Mantri Fasal Bima Yojana

- Pradhan Mantri Krishi Sinchayee Yojana
- National Agriculture Market (e-NAM) platform
- National Mission for Sustainable Agriculture (NMSA)
- Integrated Watershed Management Programme
- National Food Security Mission
- Kisan Call Centre
- mKisan portal

Agri Tech Start-up Case Studies:

- **AgriApp Technologies:** It works to make the farmers ready for high-efficiency technology-enabled agriculture production and marketing.
- **Khetee:** It promotes agroecological farming through the agroforestry model.

- **Pudhuvai Green Gas:** It produces organic waste agro-raw materials and bio-fertilisers.

Conclusion

Sustainable agriculture benefits farmers by maintaining the environment, providing food security, and improving their livelihoods. Sustainable agriculture practices have the potential to increase agricultural productivity, lower production costs, and improve crop quality. It may also encourage the creation of better and safer foods, which is good for public health.

Farmers can use modern technologies to construct sustainable farming systems that promote environmental, social, and economic sustainability. To achieve sustainable farming systems, it must be combined with other sustainable farming practices.



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Climate Sustainable Agriculture

- Agriculture is going to encounter severe challenges in the coming years and decades for the simple reason that climate change and its attendant consequences are now a reality. The problem is made worse by the fact that the world's food output would need to expand by roughly 70% by 2050 to feed its ever-increasing population.
- As a result, the world needs to develop ways to achieve sustainable agriculture, and the answer lies in Climate Smart Agriculture (CSA).
- There can be no doubt after several studies conducted by the Indian Government and other international organisations that one of humanity's largest concerns will be ensuring food security in the face of growing population.
- The relative rates of increase in yield for key cereal crops are falling, according to data from the Food and Agriculture Organisation (FAO). The food security crisis will only worsen, as the globe will need to produce almost 70% more food by 2050 to feed an anticipated 9 billion people, while the population is expected to reach 11 billion by 2100 (UN Population Division report).
- Rising temperatures as a result of global warming have already begun to reduce the output of food grains and other agricultural crops. Temperatures are expected to rise 2-5°C in the future climate by 2100 (IPCC, 2014). The relationship between global warming and agriculture is interesting since they are interconnected.
- Rising temperatures decrease crop yields: maize (-7.4%), wheat (-6.0%), rice (-6.2%), soybeans (-3.1%).
- Climate change causes annual agriculture losses of US\$ 9-10 billion, with potential cereal grain reductions of 20-40%.
- Agriculture, forestry, and land-use changes contribute 25% of human-induced greenhouse gas emissions.

Climate-Smart Agriculture (CSA):

- As defined by the World Bank, 'Climate-smart agriculture (CSA) is an integrated approach to managing landscapes – cropland, livestock, forest and fisheries, that address the interlinked challenges of food security and climate change.'
- Climate-Smart Agriculture (CSA) seeks to promote long-term agricultural sustainability by addressing climate change and environmental concerns.
- The goals of CSA are primarily three-fold:
 - Increased productivity - According to a 2020 World Bank estimate, approximately 690 million people, or 8.9 percent of the global population, are hungry, an increase of nearly 60 million from 2015. Saving this population from starvation in the first place and providing them with the essential nourishment are the two key factors of enhancing agricultural output productivity.
 - Enhanced resilience - Developing crops that can withstand extreme weather conditions such as drought and flooding, as well as pests, diseases, and other climate-related risks and shocks; and improving capacity to adapt and grow in the face of longer-term stresses such as shortened seasons and erratic weather patterns are the major goals of enhancing resilience.
 - Lower emissions - Agriculture is a major contributor to global warming. As a result,

Challenges in Agriculture:

- The situation for agri-production is a two-way challenge:
 1. to shield the production from the effects of global warming, and
 2. to increase the production for a larger population in the years to come despite the symptoms of global warming.

it is critical for climate-smart agriculture to find strategies to cut emissions per kilo of food produced, avoid deforestation, and identify techniques to absorb carbon from the atmosphere.

- To address the effects of climate change on agriculture, resilient crop types must be developed.
- Climate-smart crops should be able to withstand a variety of threats such as pests, frosts, and extreme weather events.
- To make climate-smart crop types available to farmers, efficient production and distribution are required.

To effectively implement a climate-smart agriculture strategy, there are some components that are recommended by FAO:

- Create drought-resistant agricultural varieties and include farmers in decision-making.
- Increase farm resilience and profitability by diversifying crops and organisms.
- Combat the consequences of climate change on pests, diseases, and weeds holistically.
- Make water resource management a top priority in order to handle rising water scarcity.
- Soil protection can be achieved through integrated landscape planning and sustainable management practices.
- Increase output and lower emissions by using appropriate machinery and precision farming.

To mitigate the impending impact, the Government has taken many initiatives, some of which are as follows:

- **National Innovation on Climate Resilient Agriculture (NICRA):** Launched in 2011 with a Rs. 350 crore investment to improve the resilience of Indian agriculture to climate change. Dedicated to the advancement of climate-resilient technologies and practices.
- **National Mission on Sustainable Agriculture (NMSA):** The NMSA works through the adoption of a sustainable development pathway by gradually transitioning to environmentally friendly technology, the use of energy efficient equipment, natural resource conservation, integrated farming, and so on. In addition, the NMSA strives to promote location-specific improved agronomic practices such as soil health management, increased water usage efficiency, chemical judiciousness, and crop diversity.
- **National Adaptation Fund for Climate Change (NAFCC)** – It was formed to cover

the costs of climate change adaptation for India's states and union territories that are particularly vulnerable to the detrimental effects of climate change. This Scheme was implemented in 2015-16 primarily to support real adaptation measures aimed at limiting the negative consequences of global climate change in a variety of industries, including agriculture.

- **Climate Smart Village (CSV):** This is an institutional strategy to testing, implementing, modifying, and promoting CSA at the local level, as well as improving farmers' ability to adapt to climate change. CSVs were first tested in two Indian states: Haryana's Karnal district and Bihar's Vaishali district, before spreading to Punjab, Andhra Pradesh, and Karnataka.
- **Paramparagat Krishi Vikas Yojna (PKVY):** It is an expanded component of Soil Health Management (SHM) that was launched in 2015 under the NMSA with the goal of supporting and promoting organic farming through the adoption of an organic village by cluster approach, which results in improved soil health.
- **Biotech-KISAN:** It is a scientist-farmer partnership initiative for agriculture innovation that was started in 2017 with the goal of connecting science laboratories with farmers to identify creative ideas and technologies to be utilised at the farm level. So far, 146 Biotech-KISAN Hubs have been built under this scheme, spanning all 15 agroclimatic zones and 110 aspirational districts in the country.
- **Sub-Mission on Agro-forestry:** Launched in 2016-17 with the objective of planting trees on farm bunds and aims to bring sustainability in agriculture and mitigate the impact of climate change.
- **National Livestock Mission:** Launched in 2014-15 with a focus on livestock development through sustainable approach and aims to protect the natural environment, conserve animal biodiversity, and ensure farmers' livelihood.
- **National Water Mission (NWM):** Launched to ensure Integrated Water Resource Management (IWRM) for conserving water sources and minimizing wastage. Aims to optimize Water Use Efficiency (WUE) by 20% including the agriculture sector.

Conclusion

- The Indian government has actively begun the process of assessing the impact of climate

change on agriculture, supplemented by robust actions. India's fertiliser policy have grown positively by increasing crop yield and productivity. The additional food grain output of 13.66Mt using fertilisers averted the conversion of 11.48 million hectares of forest area to farmland, resulting in a reduction of GHG emissions of 13.66 Mt in 2013.

- In addition, neem coated urea has lowered fertiliser input costs, enhanced nutrient usage

efficiency, and reduced GHG emissions from fertiliser nutrient sources.

- There has been a concerted push in India to promote Zero Budget Natural Farming (ZBNF). It provides a commercially feasible and environmentally benign option, as well as better climatic adaptation than conventional agriculture. The area under agroforestry is increasing, resulting in more carbon fixation and lower GHG emissions.





Dryland Farming

- Dryland farming is a difficult practice that necessitates an awareness of local climate and soil conditions, the selection of appropriate crops, and the application of relevant technologies.
- Dryland farming is the production of crops under natural rainfall circumstances with little or no irrigation.
 - Dryland areas are distinguished by low rainfall ranging from 375 mm to 1125 mm, which is irregularly distributed, highly erratic, and unpredictable.
 - Because of their reliance on rainfall, these places are less productive and economically vulnerable, making them more vulnerable to environmental pressures and shocks.
 - The soils in these places are often poor or deteriorated, with limited water retention capacity and numerous nutrient deficits.
 - The distribution of rainfall over the crop cycle is typically unbalanced, with crops receiving a lot of rain when it isn't needed and not enough when it is.
 - Dryland areas are frequently more vulnerable to drought and drought-like conditions due to poor soil structure and depleted ground water tables.
- irrigation in areas receiving rainfall around 1150 mm, mainly in humid and sub-humid regions.
- **Major Crops in Dryland Agriculture**
 - Millets, oilseeds, pulses, maize, cereals, and cotton are important crops.
 - Millets are drought-resistant, climate-resilient, and eco-friendly crops.
 - Oilseeds and pulses play a significant role in rainfed regions, contributing to vegetable oil production and soil health.
- **Supporting Schemes:**
 - **Per Drop More Crop, Soil Health Card, and Paramparagat Krishi Vikas Yojana** contribute to dryland agriculture improvement.

Importance of Dryland Farming

- **Diverse Agro-climatic Zones:** Due to India's unique geographical location, climatic conditions and agricultural patterns vary across the country.
- **Climate Change:** Dryland farming contributes to climate change mitigation while also ensuring long-term food security.

Challenges Associated with Dryland Farming

- **Rainfall Dependency:** Dryland farming is dependent on natural rainfall, rendering it vulnerable to variable and unpredictable rainfall patterns.
- **Soil and Nutrient Constraints:** Dryland areas frequently feature weak or deteriorated soils with inadequate water-holding capabilities and nutrient deficits.
- **Drought susceptibility:** Dryland areas are vulnerable to drought and diminishing groundwater levels.
- **Small Land Holdings:** Dryland farming is challenging due to fragmented and small land holdings.

Distribution and Contributions

- In India, terms like dry farming, dryland farming, and rainfed farming are often used interchangeably, but technically they are a bit different depending on the quantum of rainfall.
 - **Dry farming:** Practiced in areas with an annual rainfall of less than 750 mm and a crop growing season under 200 days.
 - **Dryland farming:** Cultivation in regions with rainfall ranging from 750 mm to 1150 mm, including semi-arid areas.
 - **Rainfed farming:** Crop cultivation without

Strategies for Sustainable Dryland Farming

- **Integrated Farming:** Dryland farmers can boost productivity by using integrated farming strategies with different crops.
- **Crop Selection:** To maximise productivity in dryland circumstances, suitable crops that are adapted to the environment must be chosen.
- **Adoption of Technology:** Using drip irrigation, water harvesting, and precision farming increases water-use efficiency and yields.
- **Soil Conservation:** Practices such as contour ploughing, terracing, and mulching can help to reduce erosion and retain soil moisture.
- **Capacity Building:** Empower farmers through dryland agricultural techniques training and knowledge transfer.
- **Market Assistance:** Improve market infrastructure and value chains to increase profitability and market access.
- **Research and Development:** Continued research and development efforts are required to produce crop types and technology for dryland farming.

Way Forward

- CRIDA (Central Research Institute for Dryland Agriculture) has created 'The Vision 2050'.
- Location-specific research, rainwater harvesting, and soil health management are prioritised.
- Integrated agricultural modules to protect small and marginal farmers from danger.
- Using cutting-edge technology such as remote sensing and GIS to characterise resources.
- Product development based on nanotechnology for dryland agriculture.
- Energy efficiency, precision agriculture, and renewable energy sources are being implemented in dryland areas.

Conclusion

Despite its limitations, drier farming has enormous potential for sustainable agriculture in India. Dryland farmers can overcome limits and achieve plentiful crop production by recognising local conditions, implementing appropriate practices, and giving required support. This contributes to food security and rural development.

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Sustainable Agriculture: Challenges and Way Forward

- Sustainable agriculture is a sort of agricultural practice that focuses on the prudent use of finite resources while considering nature and future generations. This notion advocates for the utilisation of renewable energy, the conservation of land, and the elimination of natural pollution.
 - According to the definition of FAO – “Sustainable agricultural development is the management and conservation of the natural resource base and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations.
 - Such development conserves land, water, plant, and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable, and socially acceptable”
 - According to this definition, sustainable agriculture practices have five major principles:
- **Three Pillars of Sustainable Agriculture:**
 - **Economy:** This ensures the growth and profitability of the business for the farmers through the efficient use of viable resources.
 - **Society:** This pillar ensures enough food for the world’s growing population and fair employment and compensation opportunities for the local community.
 - **Environment:** This pillar ensures the environment’s protection through ecologically sound farming practices and less use of replenishable resources.

Major Sustainable Agriculture Practices:

- 1 Continuous production of crops.**
- 2 Protection and conservation of natural resources like soil, water, etc.**
- 3 Improve the social and economic well-being of the people.**
- 4 Use state-of-the-art technology**
- 5 Require government support for the institutional changes in production, marketing, law enforcement, etc.**

- Sustainable agriculture is a much-needed alternative to conventional input-intensive agriculture, which in the long term degrades the topsoil, results in declining groundwater levels, and reduces biodiversity.
- **Reducing Tillage:** No-till or reduced-fill methods involve inserting seeds directly into undisturbed soil, which can reduce erosion and improve soil health.
- **Integrating Livestock and Crops:** Livestock can feed on the by-products of the farms and crops can receive abundantly rich natural fertilisers and manure.
- **Adopting Agroforestry:** Planting trees along with the crops conserves the soil cover and local water resources but also provides an additional source of income to the farmers.
- **Grow the Cover Crops:** By sowing cover crops off-season, farmers can protect their fields from soil erosion and soil degradation. This acts as green manure for the crops.
- **Integrated Pest Management:** It aims at long-term protection of crop cover on farms by mitigating pest attacks.

Sustainable Agriculture and Use of Technology

Technological development and the rate of innovation have always influenced the stability and sustainability of agricultural production. Technology in the field of agriculture has affected the productivity of agriculture and thus acts as the backbone of sustainable agriculture. Technological advancement in agriculture involves

- Development of nutrients,

- Development of Pest control methods,

- Development of agriculture-related machinery and equipment,

- Development of genetically modified crops providing greater nutritional efficiency (more calories per yield, or more yield),

- Manipulation of natural pest control agents,

- Discovering efficient farm management techniques that focus on whole-farm productivity over time,

- The use of computational technology, combined with geographical location devices and remote sensing advancements will help the genetically modified seeds provide site-specific solutions,

- The Use of environment modelling along with risk management algorithms will assist farmers in combating the uncertainties related to drought, floods, etc.

Sustainable Agriculture in India

- Sustainable agriculture practices in India refers to less resource-intensive farming solutions, greater diversity in crops and livestock, and farmers' ability to adapt to local circumstances. But still in India, the coverage of Sustainable Agriculture practices is very low. According to resources:
 - Only 5 (crop rotation; agroforestry; rainwater harvesting; mulching and precision) Sustainable Agriculture practices scale beyond 5 percent of the net sown area.
 - Most Sustainable Agriculture Practices (SAPs) are being adopted by less than five million (or four percent) of all Indian farmers.
 - Crop rotation is the most popular in India, covering around 30 million hectares (Mha) of land and approximately 15 million farmers.

- Agroforestry, mainly popular among large cultivators, and rainwater harvesting have relatively high coverage of 25 Mha and 20-27 Mha, respectively.
- Organic farming currently covers only 2% of India's net sown area of 140 Mha.
- Natural farming is India's fastest-growing sustainable agricultural practice and has been adopted by around 800,000 farmers.
- Integrated pest management (IPM) has achieved a coverage area of 5 Mha after decades of sustained promotion.
- The impact and coverage of practices like floating farming, permaculture, etc. is insignificant.
- Therefore, in order to increase the coverage of SAPs, in 2014-15, the Government of India launched the National Mission for Sustainable Agriculture. This has been formulated for enhancing agricultural productivity, especially in rainfed areas focusing on integrated farming, water use efficiency, soil health management, and synergising resource conservation.

Objectives

- To make agriculture more productive, sustainable, remunerative, and climate-resilient.
- To adopt comprehensive soil health management practices.
- To optimise utilisation of water resources through efficient water management to expand coverage for achieving 'More Crop Per Drop'.
- To develop the capacity of farmers & stakeholders.

Major components of National Mission for Sustainable Agriculture

- **Rainfed Area Development (RAD):** It creates an area-based strategy to natural resource conservation and manages soil nutrients. Common resources are being built, such as a grain bank, fodder shredders, and a coordinated marketing push.
- **On-Farm Water Management (OFWM):** Promotes innovative on-farm water conservation equipment and methods for optimal water utilisation.
- **Soil Health Management:** It supports long-term practices that conserve soil health based on location and crop type.

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Major Challenges/Roadblocks in Sustainable Agriculture

- The budgetary allocation to NMSA is less. It is only 0.8 per cent of the Ministry of Agriculture and Farmers' Welfare's total budget.
- SAP are knowledge-intensive techniques which require knowledge exchange among the farmers.
- Capacity building among the different types of farmers.
- SAPS are labour-intensive and difficult to adopt by medium to large farmers.

Based on the above context, some key recommendations for the successful adoption of sustainable agriculture practices in India are-

Rainfed areas should be focused on as the area of primary gain because they are already performing low-resource agriculture.

Authorities should prepare the full taxonomy for sustainable agriculture in India. It includes policies, guidelines, and legal frameworks.

Proper focus should be kept on knowledge exchange and capacity building among farmers and agriculture extension workers.

Authorities should extend short-term transition support to farmers liable to be adversely impacted by a large-scale transition to sustainable agriculture.

Financial support should be provided for research in the field of sustainable agriculture.

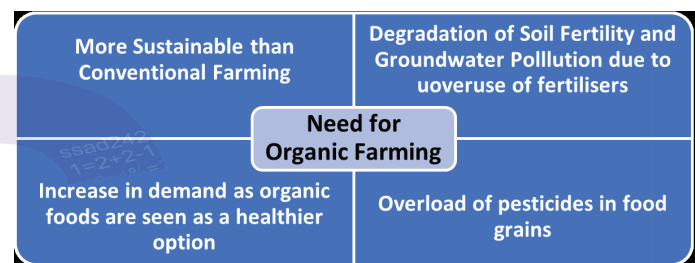
Use of technology in this field in India is negligible. In order to support the formalisation of agrotech, a proper system should be made for the leveraging of data and technology

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Organic Farming: Status and potential

- Organic agriculture is described by the National Standard of Organic Production (NSOP) as “a system of farm design and management to create an ecosystem capable of achieving sustainable productivity without the use of artificial off-farm inputs such as chemical fertilisers and pesticides.”
- Organic farming is seen as a climate-friendly farming practice since it encourages low external input utilisation, recycling, reuse, and the use of fewer synthetics in farming. It is a climate-friendly practice that reduces the use of synthetics in farming and promotes low external input usage, recycling, and reuse.
- Organically grown foods generally contain higher levels of antioxidants, certain micronutrients, no harmful chemicals, pesticides, fertilisers, are better tasting, and most importantly, aid in the sustainability of the planet and in maintaining ecological balance.
- Thus, organic farming needs to be adopted on a large scale to have a far-reaching impact on the health of our citizens as well as on the health of our soil.
- Sikkim is India’s first completely organic state, having converted all of its cultivable lands to organic certification.

Need for organic farming



Export of organic food from India

- The Agricultural and Processed Food Products Export Development Authority (APEDA) is the nodal body in charge of promoting agricultural and processed food product exports, including organic products.
- The United States, the European Union, Canada, the United Kingdom, Turkey, Australia, Switzerland, Ecuador, and Japan are among the top export destinations for Indian organic products.
- Soya meal (61%), oilseeds (12.58%), cereals and millets (12.71%), sugar (4.77%), and plantation crops (2.16%) are India’s principal organic product exports.

Overview of Organic Farming

- According to the 2021 FiBL survey, organic farming is practiced in 187 countries, with Australia (35.69m hectares), Argentina (3.63m hectares), and Spain (2.35m hectares) having the most organic agricultural land.
- India is home to 30% of the world’s organic producers, although organic farming accounts for only 2% of the country’s total net sown area.
- Madhya Pradesh is India’s leader in organic agricultural land, with 0.76 million hectares under organic cultivation, accounting for 27% of total organic farming area.
- Madhya Pradesh, Rajasthan, and Maharashtra account for half of India’s organic farming land.

Organic agricultural products exported during last 3 years

S. No.	Year	Exported Qty (In MT)	Value (In Cr)	Value (In USD Millions)
1	2021-22	460320	5249.32	71.96
2	2020-21	888179	7078.50	1040.96
3	2019-20	638998	4686.00	689.10

Government initiatives to promote organic farming

- The **Paramparagat Krishi Vikas Yojana (PKVY)** and Mission Organic Value Chain Development for Northeastern Region provide farmers with full assistance in production, processing, certification, marketing, and post-harvest management.
- **Paramparagat Krishi Vikas Yojana (PKVY)**
 - Under PKVY, farmers earn Rs. 50,000/ha for three years to form Farmer Producer Organisations (FPOs), purchase organic inputs, and receive training, assistance, and certification.
 - Additionally, Rs. 20 lakh is paid for 1000-hectare cluster for value addition and infrastructural development.
 - Since 2015-16, 11.85 lakh acres of land has been converted to organic farming, with an additional 6 lakh hectares targeted by 2026.
- **Mission Organic Value Chain Development for the Northeastern Region (MOVCD-NER)**
 - MOVCD-NER pays farmers Rs. 46,575 per hectare for three years in order for them to

build FPOs, procure organic inputs, and receive training, advice, and certification.

➤ Furthermore, need-based support is provided for the establishment of integrated processing units, collection and grading facilities, pack houses, and refrigerated vehicles.

➤ Through this mission, 1.73 lakh hectares of land have been converted to organic farming since 2015-16.

- **Organic certification scheme:**

- It ensures conformity with organic standards by having an impartial organisation assess the entire production, processing, handling, storage, and shipping process.

- The Ministry of Agriculture and Farmers' Welfare's Participatory Guarantee System certifies organic products, ensuring that production adheres to quality requirements.

- The dedicated web platform, www.jaivikkheti.in, was created to assist farmers in obtaining better pricing for their organic food.

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Millets: Future of Sustainable Agriculture

Millets are a type of small-seeded grass that is also known as nutri-cereals or dry-land cereals. They have the potential to improve nutritional balance, reduce dependence on water-intensive crops like rice, and ensure food security for all.

Overview of millet cultivation in India

- India is the world's biggest millet producer, accounting for 19% of global production and 20% of millet-growing land.
- In India, the three most common millet kinds are pearl millet (bajra), sorghum (jowar), and finger millet (ragi). Out of these prime varieties of Indian millets, bajra and jowar together contribute about 19 per cent of the world's production.
- Andhra Pradesh, Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, Tamil Nadu, Uttar Pradesh, and Uttarakhand are the top ten millet-producing states in India. These ten states produce 98% of the millet in India.
- Of these states, Gujarat, Haryana, Karnataka,

Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh account for 83% share of millet production.

- The recent drive for the promotion of millet is due to nutritional values, environment-friendly cropping patterns, and its remunerative potential.
- The importance of millets is emphasised by the United Nations Food and Agricultural Organisation, FAO Stat 2021, which states that India accounts for 19 percent of the overall area under millets cultivation and 20 percent of total millet production in the globe.
- Furthermore, India has a greater average production of 1,239 kilograms per hectare (kg/ha) than the global average of 1,229 kg/ha.

Nutritional value of millets

Most millets have a high protein, fibre, vitamin, and mineral content. They are also an appealing gluten-free option for cereals, with minimal fat absorption and low glycemic indices. As a result, they are an excellent source of nutrients for people of all ages.

Table 1: Nutritional Profile of Millets and Cereals (per 100 g)

Grains	Energy (kcal)	Protein (g)	Carbohydrate (g)	Starch (g)	Fat (g)	Dietary Fibre (g)	Minerals (g)
Sorghum	334	10.4	67.6	59	1.9	10.2	1.6
Pearl millet	363	11.6	61.7	55	5	11.4	2.3
Finger millet	320	7.3	66.8	62	1.3	11.1	2.7
Proso millet	341	12.5	70.0	-	1.1	-	1.9
Foxtail millet	331	12.3	60.0	-	4.3	-	3.3
Kodo millet	353	8.3	66.1	64	1.4	6.3	2.6
Little millet	329	8.7	65.5	56	5.3	6.3	1.7
Barnyard millet	307	11.6	65.5	-	5.8	-	4.7
Maize	334	11.5	64.7	59	3.6	12.2	1.5
Wheat	321	11.8	64.7	56	1.5	11.2	1.5
Rice	353	6.8	74.8	71	0.5	4.4	0.6

Source: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8871339/#B3-foods-11-00499>

Environmental Sustainability

- **Adaptability:** Millets are versatile crops that can be cultivated in a range of circumstances. They are drought tolerant and can withstand a wide range of temperatures.
- **Mixed cropping:** Millets can be cultivated in mixed cropping systems, which improves soil fertility and reduces insect load.
- **Irrigation:** Millets demand less water than other cereals like rice and wheat. As a result, they are an excellent choice for farmers in locations with limited water supplies. Paddy, for example, requires a temperature of 25 degrees Celsius and an annual rainfall of more than 100 cm, but jowar can be produced in places with less than 20 cm of annual rainfall.

- **Cropping duration:** Because millets have a shorter cropping length than other cereals, they are good for crop rotation.

Initiatives for promoting millet production and consumption

- **Production**
 - The government's Minimum Support Price Programme supports millet cultivation by guaranteeing farmers a fair price for their crops and lowering the risks involved in millet cultivation.
 - In comparison to other crops like paddy, millets have a higher return over cost for the crops covered by the MSP.

Crop	MSP 2014-15	MSP 2022-23	MSP 2023-24	Cost* of production 2022-23	Increase in MSP (Absolute)	Return over cost (in per cent)
Paddy	1,360	2,040	2,183	1,455	143	50
Jowar	1,530	2,970	3,180	2,120	210	50
Bajra	1,250	2,350	2,500	1,371	150	82
Ragi	1,550	3,578	3,846	2,564	268	50

Consumption:

- The Targeted Public Distribution System (TPDS), Pradhan Mantri Poshan Shakti Nirman (PM-POSHAN), Integrated Child Development Scheme (ICDS), One District One Product (ODOP) scheme, and Submission on Nutri-Cereals under National Food Security Mission are just a few of the initiatives the Indian government is promoting millet consumption through.
- The Indian Institute of Millets Research (IIMR), which will open in Hyderabad, will study millets and exchange best practices with other nations.
- Consumer education campaigns promoting

millet's advantages are being carried out through the publication of commemorative coins and stamps, the Food Corporation of India's nutritional programmes, etc.

Conclusion:

- Indian millets should adhere to Western sanitary and phytosanitary norms in order to increase exports. Furthermore, it is necessary to develop a strong supply and value chain from pre-production to processing and marketing.
- The renewed focus on millets has the potential to have positive externalities, such as increased income for growers, greater nourishment for citizens, and environmental sustainability.



Contribution of Women to Sustainable Agriculture Development

- In India, the agriculture industry accounts for 45.6% of total employment and 17.32% of gross value added.
- Understanding the gender dividend (the contribution of women) in agriculture is vital because it has the potential to enhance farm yields by 20 to 30 percent and increase agricultural productivity by 2.5 percent.
- Agriculture sector remains the prime pulse for economic growth, poverty alleviation, and environmental sustainability.
- Rural women contribute significantly in three different ways depending on the socio-economic status of their family. They contribute as paid labourers, unpaid labourers doing labour on their own/family-owned land, and managers/supervisors in agricultural production and post-harvest operations. Besides, they also play an important role in the maintenance of natural processes and ecosystem services and adopt an integrated perspective on farming system that emphasises sustainable agricultural practices and resource-use efficiency.
- Importance of Women in Agriculture and Allied Services
- As agriculture has been more “feminised,” women’s responsibilities have expanded as they work as paid employees, unpaid labourers (on land owned by their families), and managers in agricultural production and post-harvest operations.
- Women are critical in the management of land and water resources because they gather the water, firewood, and feed needed for agriculture.
- They engage in a variety of activities linked to raising animals, growing vegetables, processing seafood, making dairy products, etc.
- The United Nations Food and Agriculture Organization estimates that if women had the same access to productive resources as men,

they could increase yields on their farms by 20-30% leading to higher agricultural output in developing countries and a dramatic reduction in hunger.

Changing trends in Agriculture

- Agriculture’s social and cultural dimensions have been subject to shifting trends. Men are moving to metropolitan regions in pursuit of gainful jobs, leaving women to manage the farmlands, which has resulted in the “feminization of agriculture,” which has increased the role of women.
- Other variables include the increase in homes led by women and the expansion of the production of cash crops, which require a lot of effort and are predominantly managed by women.
- Even though women are now de facto managing both farm and non-farm activities, especially in dryland areas, their typical work is still restricted to lower-skilled tasks like planting, transplanting, weeding, and harvesting as well as caring for livestock, among other things that fall under the general definition of domestic life.
- It is also extremely typical for women to labour in agriculture as unpaid subsistence workers. Even if the number of tasks performed by women—both on farms and in non-farm activities—is rising, these efforts are frequently seen as an extension of their household duties, creating a second load of domestic responsibilities.

Challenges Faced by Rural Women in Agriculture

- **Lack of recognition:** Women’s contributions as primary producers are frequently disregarded, and they are only seen as social service recipients.
 - This keeps people stuck in a cycle of drudgery, poor skill development, and exclusion from decision-making.
- **Skill development:** Due to a lack of

opportunities for skill development, women were forced to perform low-skilled, boring, and time-consuming farm tasks.

- If they aren't given the chance to learn new skills, including operating machines, the mechanisation of agriculture threatens their involvement.
- **Land ownership and records:** Only 13.9 percent of operational holdings are owned by women, which reflects both the gender ownership gap in land and the practice of widespread land fragmentation.
 - The Hindu Succession Act of 2005 grants daughters equal rights in inherited property, however this is not the case for agricultural land.
- **Poor credit access:** Women cannot get credit because they do not possess assets.
 - Because of their strict restrictions and restricted borrowing history, female customers at rural financial institutions are reluctant to use their services.
- **Inequality in market access:** Access to the market is unequal for women due to gender discrimination, which also limits their access to jobs and other chances for employment.

Recognising the critical role of women as equal partners in sustainable development, the government has embarked upon various pro-women initiatives in a big way since 2007, and earmarked at least 30% of benefits and resources for women under all beneficiary oriented interventions.

- **NABARD's SHG Bank - Linkage Programme** to solve the issue of access to credit of women farmers and self-help groups (SHGs) by relaxing the requirement of collateral for extending loans has definitely proved to be a remarkable milestone.
- The adoption of **NABARD's Joint Liability Group (JLG)** Ram Rahim model by Kerala's

Kudumbshree accelerated the pace of empowerment among women farmers who undertook collective farming under the model.

- The **Mahila Kisan Sashaktikaran Pariyojana**
- Encouraging women's leadership roles in **Farmer Producer Organisations (FPOs)**.
- Skill development programs under the **Pradhan Mantri Kaushal Vikas Yojana**.
- Financial inclusion schemes like **Pradhan Mantri Jan Dhan Yojana and Pradhan Mantri Mudra Yojana**.

Way Forward

- Improving recognition, entrepreneurship chances, and financing access.
- Women's participation can be increased by establishing female Farmer Producer Organisations under the central government's 10000 FPOs scheme and by ensuring that they have access to resources and land records.
- Alternative strategies may be used in cases where state governments have not changed tenancy legislation. For instance, the state government of Andhra Pradesh issued a Loan Eligibility Card (LEC) as one efficient alternative.
- Direct access to data on expanded market connections and better agricultural practises, especially through digital platforms.

Conclusion

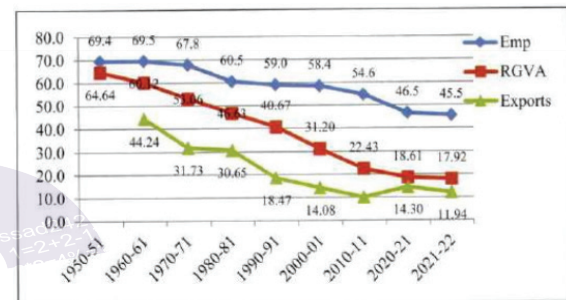
- Although government initiatives, skill development programmes, and financial inclusion schemes have made advancement, additional effort is still required.
- We can unleash the potential of women farmers, boost agricultural output, and build a more just society by giving them more control over their lives.



Paving the Way for Sustainable Growth

- Agriculture continues to be the most crucial sector of Indian economy. Over the past seven decades, the country has experienced substantial growth in food grain production, outpacing population growth and resulting in a significant increase in per capita availability of foodgrains.
- The liberalisation of the economy has led to a transformation of the farm sector, shifting from traditional food crops to commercial and horticultural crops.
- Agriculture along with the allied sectors, plays a strategic role in the process of economic development by bolstering national income, output, employment, and foreign exchange earnings.
- The significance of this sector is brought out by the fact that more than 50 per cent of the total work force derives its sustenance through direct employment in agriculture, either as cultivators or as agricultural labourers.
- Due to remarkable progress of this sector, India has emerged as the seventh largest exporter of agricultural products in the world.
- Agriculture remains a vital component of India's economy, supporting over half of the workforce. Although its contribution to GDP (64.64% in 1950-51 to 17.92% in 2021-22) and employment have declined, it remains significant compared to the global average.

Figure 1: Share of Agriculture & Allied Sector in Gross Value Addition, Employment and Exports (%)

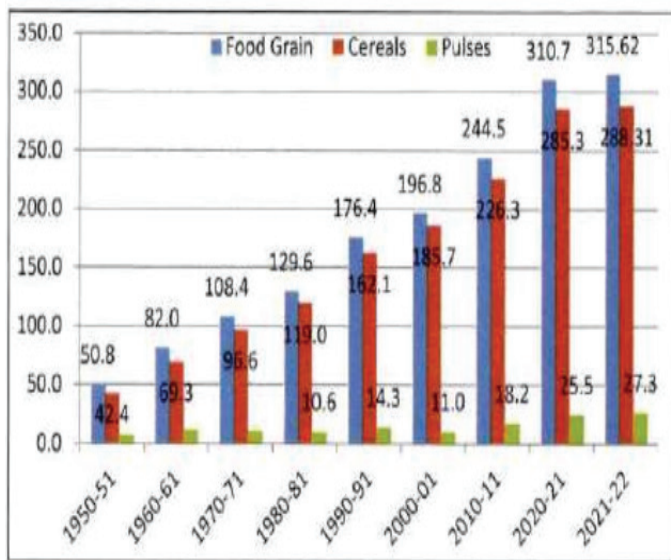


Sources: (i) NSSO, Periodic Labour Force Survey 2021-22, February 2023.

Trends in Agriculture Production

- The major food crops in the country are cereals like rice, wheat, maize, jowar, bajra, etc., and pulses like gram, tur, moong beans, masur, peas, etc.
- The major commercial crops in India are cotton, jute, tea, rubber, sugarcane, oil seeds, etc.
- Among commercial crops, potatoes witness the highest annual compound growth rate of 5.0 percent followed by rubber which is 3.97% and cotton which is 3.33% from 2020-21 to 2021-22.

Commodity	1950-51	1970-71	1990-91	2010-11	2020-21	2021-22	CAGR (%)
Foodgrains	50.8	108.4	176.4	244.5	310.74	315.62	2.61
Cereals	42.4	96.6	162.1	226.3	285.28	288.31	2.74
Pulses	8.4	11.8	14.3	18.2	25.46	27.3	1.67
Oilseeds	5.2	9.6	18.6	32.5	36.57	37.7	2.83
Sugarcane	57.1	126.4	241	342.4	405.4	431.8	2.89
Cotton@	3.04	4.8	9.8	33	35.25	31.2	3.33
Jute & Mesta#	3.3	6.2	9.2	10.6	9.35	10.32	1.62
Tea	0.28	0.4	0.7	1	1.4*	-	2.36
Coffee	-	0.1	0.2	0.3	0.3*	-	2.22
Rubber	-	0.1	0.3	0.8	0.7*	-	3.97
Potato	-	4.8	15.2	42.3	56.17	53.39	5.01
Milk	17	22	53.9	121.8	210.0	221.1	3.68
Egg (Million No)	1832	6172	21101	63024	122049	129600	6.18
Fish	0.75	1.76	3.84	8.4	14.7	16.2	4.42



Trends in Horticulture Production

- Over the past two decades, the horticulture sector in India has seen remarkable growth.
- Horticulture production reached 342.33 million tonnes in 2021-22, up from 145.79 million tonnes in 2001-02.
- The production of horticulture crops has exceeded foodgrain production since 2012-13.
- India is now the second-largest global producer of fruits and vegetables, trailing only China.
- Additionally, it holds the top positions in spice production, consumption, and exportation.

Table 2: Horticulture Vis-a-vis Foodgrain Production in India
(quantity in million tonne)

Year	Food Grain	Horticulture	Vegetables	Fruits	Other
2001-02	212.9	145.79	88.62	43.00	14.17
2005-06	208.6	182.8	111.40	55.36	16.04
2010-11	244.5	240.5	146.55	74.88	19.07
2015-16	251.6	286.2	169.06	90.18	26.95
2020-21	310.74	334.60	200.4	102.48	31.68
2021-22	315.62	342.33	204.84	107.24	30.25
CAGR (%)	1.99	4.36	4.28	4.68	3.87

Source: Agriculture Statistics at a Glance-2022.

Trends in Livestock Production

- The output of India's agricultural and related services depends heavily on livestock, which accounts for close to 30% of this output.
- For the past 20 years, India has produced the most milk in the world.
- With an amazing yearly compound growth rate of 6.18% for egg production, the poultry

industry has also seen extraordinary growth.

- The aquaculture and fishing industries make up 7% of total output, with India producing the second-most fish in the world (7.58%).
 - In order to bring about the "blue revolution," the Pradhan Mantri Matsya Sampada Yojana encourages sustainable development in the fishing industry.
 - Under the scheme, total estimated investment of Rs. 20,050 crore is to be implemented over a period of 5 years from FY 2020-21 to FY 2024-25.
 - The scheme sets an ambitious target to enhance the fish production to 22 million tons by 2024-25 and generate about 15 lakhs direct gainful employment opportunities.

Diversification of Agriculture

- Agriculture & allied sectors consist of four major sub-sectors namely, crop sector, livestock, forestry, and fisheries.
- Over the past one decade, these sub-sectors have witnessed significant changes in their contribution to the total Value of Production (VoP) in agriculture.
 - The crop sector's contribution to GVA declined from 67.39 percent in 2010-11 to 53.89 percent in 2021-22, while the livestock sector's share in VoP shot up from 19.02 percent to 30.47 percent during the same period.
 - Furthermore, the fishing and aquaculture sub-sector also experienced improvement in its contribution from 4.35 percent to 6.86 percent over the last decade.
 - Within the crop sector, various categories have been included, such as field crops, plantation crops, horticultural crops, and narcotic crops. Notably, within the crop sector, there has been a shift towards the cultivation of commercial, plantation, and horticultural crops, including fruits, vegetables, spices, etc.
 - The liberalisation of the Indian economy has created ample scope for the development of agricultural sector, driven by increased domestic and foreign demand.

Trends in Agricultural Trade

- Presently, India has not only achieved self-sufficiency in food grains but also emerged as a prominent net exporter of agricultural products, occupying seventh position in the world.
- Though the exports of agricultural

commodities started to pick up after 1970-71, a substantial boost was witnessed from 1994-95 onwards, following the implementation of global trade reforms and progressive reductions in agricultural tariffs under the WTO regime.

- The export basket of India includes a diverse range of agricultural and allied products, such as rice, pulses, fruits, vegetables, tea, coffee, tobacco, spices, sugar & molasses, cashew, raw cotton, fish, meat, and processed food.

- It is noteworthy that whereas the overall balance of trade in India has consistently been negative, the trade balance of agricultural goods has not only been positive but also increased nearly 30 times during the last three decades, which reflects the pivotal role of agriculture in generating foreign exchange for the nation. In the wake of liberalisation, the composition of Indian agricultural exports has undergone a substantial transformation.

Table 3: Trends in Agricultural Exports and Imports of India (Amount in Crore)

Years	Agriculture Exports	Percentage of Agriculture Exports to Total Exports	Agriculture Imports	Percentage of Agriculture Imports to Total Imports	Agriculture Trade Balance
1990-91	6013	18.49	1206	2.79	4807
1995-96	20398	19.18	5890	4.8	14508
2000-01	28657	14.23	12086	5.29	16571
2005-06	45711	10.78	15978	3.26	29733
2010-11	113047	10.28	51074	3.41	61973
2015-16	215396	12.55	140289	5.63	75107
2020-21	308830	14.30	154511	5.30	154319
2021-22	375742	11.94	231850	5.07	143892
ACGR(%)	14.27		18.49		

Sources: (1) *Agricultural Statistics at a Glance, (Various Issues)* (ii) *Economic Survey (Various Issues)*.

- India's agriculture and allied products find major export markets in countries such as Bangladesh, China, Indonesia, Malaysia, Iran, Japan, Nepal, Pakistan, Netherlands, Thailand, UK, USA, and UAE.
- Despite its immense agricultural potential, India's agriculture exports currently account for 2.5% of global agri trade and less than 1.7% of world total exports.
- To enhance its agricultural export share, the Mission for Integrated Development of Horticulture (MIDH) was launched.
- Additionally, to promote horticulture products, several centres for perishable cargoes and post-harvest storage facilities

have been established with assistance from APEDA.

- Considering the diverse agro ecological zones in the country, there is huge scope to enhance its agricultural exports through focused interventions.

Conclusion

- Agriculture, the most important employment sector, necessitates the use of modern technologies, easy access to financing, low interest rates, and prompt government action in marketing to ensure fair market conditions. These policies will boost production, livelihoods, and food security.