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INDIAN ECONOMY

Major Crops & Cropping Pattern

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1. Cropping Pattern

Cropping pattern means the yearly sequence and spatial arrangement of crops on a piece of land in a given period of time.

Cropping pattern indicates the temporal and/or spatial arrangement of crops in a particular area. Knowledge of cropping patterns is crucial for crop production and land-use intensity.

There are different types of cropping patterns depending on the availability of various factors/resources (as discussed further).

Temporal Arrangements (time) refers to the yearly sequence of growing different crops on a piece of land. For example, if only one crop is grown on a particular land **year after year** (like rice in various floodplains) it is called Mono cropping.

Spatial Arrangements (space/land) refers to the arrangement of crop/s on a piece of land in various patterns. For example, if two crops are grown on a land in alternative rows it is called Row inter-cropping.

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1.1. Factors Affecting the Cropping Pattern

The cropping pattern and crop diversification in a particular geographical area depends on different categories of factors – agronomic, economic, and policy. All the factors vary in their impact on the crops under different circumstances and times.

Agronomic/Technical	Economic	Government Policy
➢ Climate and soil type (irrigation, topography, fertility, rainfall, temperature, humidity, drainage etc.) ➢ Availability of required inputs (fertilizer, chemical, credit, tractors etc.) ➢ Plant/seed of high genetic quality. ➢ Possibility of diseases and pest infestations ➢ Post-harvest storage, handling and processing facilities ➢ Management techniques and quality managers. ➢ Abundance of labour.	➢ Flow of market signals and communication and information systems, for example, regarding prices in the market, supply –demand etc. ➢ Venture capital and entrepreneurship. ➢ Transparency of input and output prices. ➢ Information on export standards, market demand and relative profitability. ➢ Efficient marketing systems.	➢ Non-distortionary policy to avoid discrimination among crops. (eg. MSP Policy) ➢ Efficient research and extension programmes, without any bias for major crops or against high value crops. ➢ Contract-farming opportunities ➢ Rural credit. ➢ Off-farm employment opportunities. ➢ Marketing systems including quality standards. ➢ Involvement of the private sector.

Apart from the above some factors related to individual farmers also determine cropping patterns such as

- **Size of the Land Holding:** In India marginal and small farmers represent the majority of the farming community. The constantly shrinking average size of these small landholdings has limited the scope for crop diversification, thus, the **mono-crop paddy** has become predominant, perpetuating subsistence agriculture with little scope for commercial crop production.
- **Condition of Household**: Food and fodder self-sufficiency requirement decides whether farmer would be able to go beyond traditional cereal and other crops such as wheat, rice or pulses.
- **Literacy:** Majority of the farmers are ignorant of the scientific methods involved in mixed-cropping, mono cropping and other technological knowhow for practicing better diversification.
- **Financial Stability:** The economic condition of the farmers also affects the cropping pattern. As the cash crops (for example, cotton) involve high capital investments, these are practised only in estate farming. The marginal section of the farms community adopts low cost crops.

1.2. Types of cropping pattern in India

Major categories of cropping pattern followed in India

Kharif (monsoon crops)		Rabi (post-monsoon crops)	
Rice based	Non-Rice -Based	Wheat and Gram Based	Rabi-Jowar Based
▸ **Relay Cropping** - seed of succeeding crops like lentil, gram, pea, lathyrus, berseem, linseed etc. is sown through broadcasting in maturing rice crop. It is done in both upland and lowland rice culture*. ▸ **Mixed varietal cropping of rice -** Mixing the seeds of early rice (ahu) with late maturing deep water rice (bao). ▸ It is mainly practiced in West Bengal.	▸ Maize-based Bajra-based Cotton-based	▸ These two crops are grown under identical climates and can often be substituted for each other.	▸ Along with Jowar, bajra, pulses, oilseeds and tobacco are grown as alternative crops.

2. Cropping Systems

A cropping system is a **broader term** than cropping pattern. It includes the sum total of all crops and the practices used to grow those crops on a field or farm. It comprises of all components, such as water, soil, technology etc. required for the production of a particular crop and the interrelationships between them and the surrounding environment.

For example, in a **Simple Cropping System** only one variety of crop is grown each year in the same field with regular fertilizer application to replenish the soil nutrients. While in a **Complex Cropping System** multiple crops like fruits, vegetables, tree crops, grain, fodder crops and livestock are all grown on a farm during a year with multiple harvests along with managed recycling of nutrients within the system.

While talking about cropping systems we tend to apply systems approach to crops.

2.1. Difference between Cropping Pattern and Cropping System

Cropping Pattern	Cropping System
Includes crop rotation practiced by a majority of farmers in a **given area or locality**.	Includes cropping pattern and its management to derive benefits from a **given resource base** under **specific environmental conditions**.
Type and **management of crops** in time and space.	The cropping patterns used on a farm and **their interaction with farm resources**, other farm enterprises and available technology which determine their make-up.
Yearly sequence and spatial arrangement of crops or crops and fallow on a given area. The **proportion of area** under various crops at a point of time in a unit area	Pattern of crops taken up for a given piece of land, or **order in which crops are cultivated** on a piece of land over a fixed period, **associated with** soil, management practices such as tillage manuring and irrigation
The two concepts are, however, overlapping, in various ways.	

2.2. Significance of a Complex Cropping System

All around the world, different variations are adopted in agriculture, which have some **common associated benefits,** such as:

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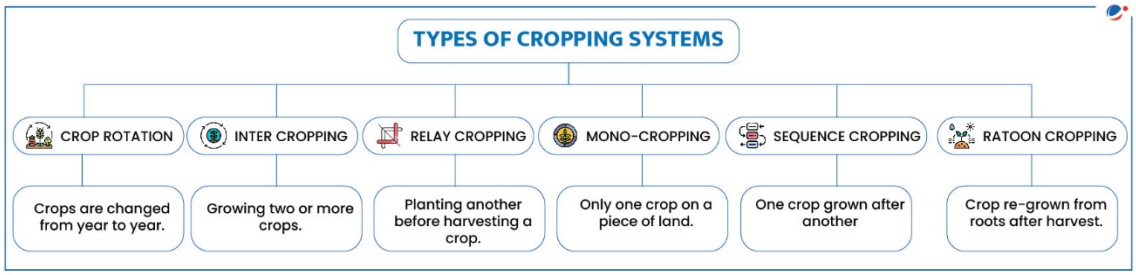
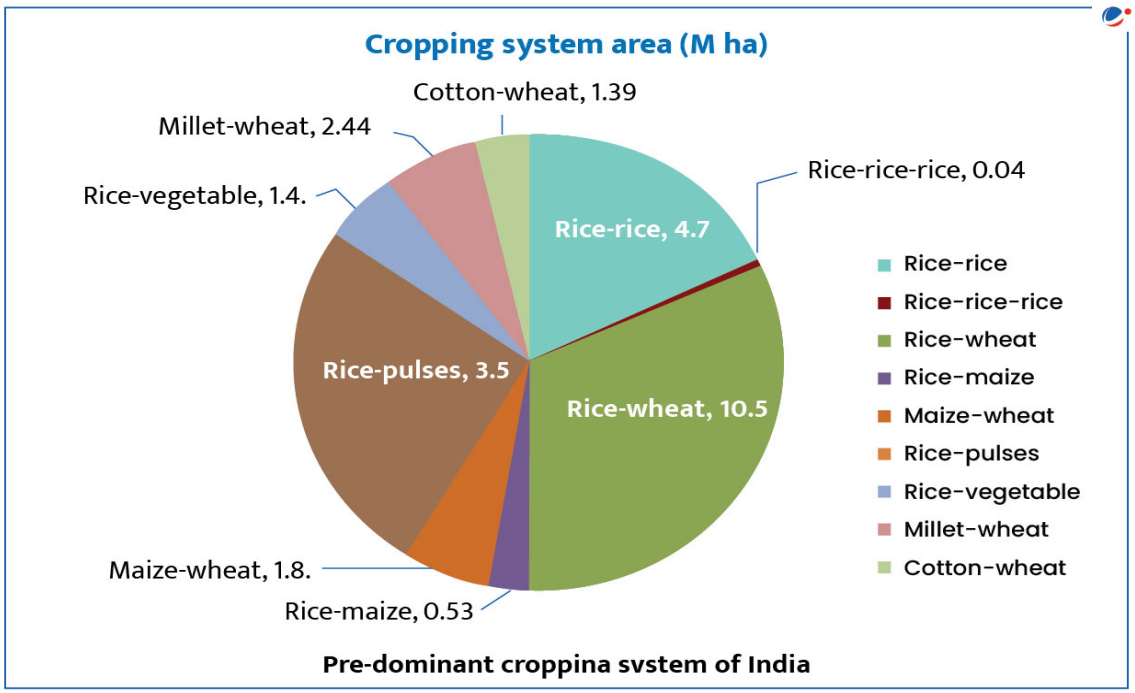
- **Maintain and enhance soil fertility**: Growing of different crops such as nitrogen fixing leguminous crops enhance the nitrogen content of soil. Growing of perennial forages and millets help to enhance soil organic content.
- **Minimize spread of diseases**: It encourages biodiversity by providing a habitat for a variety of insects and soil organisms. Some of them may act as predator for the certain diseases, thus limiting the outbreaks of diseases.
- **Inhibit pest and insect growth**: It reduces the homogeneity of farm. This heterogeneity increases the barriers against biological dispersal of pests in the field.
- **Control weed**: It reduces the likelihood that specific weed species will become adapted to the system and become problematic. For example, *rotation of crops is the most effective means yet devised for keeping land free of weeds.*
- **Use resources more effectively**: Multiple activities, if scientifically planned, lead to better usage of resources. For example, fodder crops can be used for livestock feed, animal dung can be used as organic manure and dairy products helps to enhance farmer's income.
- **Reduce risk for crop failure**: Different crops have different response to the climate vagaries and varied degree of susceptibility to disease attack. Due to such heterogeneity, the risk of total crop failure is reduced.
- **Improved food and financial security**: By reducing the risk of crop failure & diversifying the income opportunities for the famers, scientifically designed cropping system improves food and financial security.

2.3. Types of Cropping Systems



More than 250 double cropping systems are reportedly in use across nation. Among these, rice-wheat (10.5 m ha), rice-rice (5.9 m ha), and cropping systems based on coarse grains are key contributors to the nation's food production (10.8 m ha).



Pre-dominant croppina svstem of India

The dominance of cereal crops in the foodgrains point to the poverty of the people. It meets the demand of the low-income people, in whose case a large proportion of income is spent on cereals.

- Even pulses which are the source of protein for this class of people is not grown on a significant scale.
- Most of the farmers being marginal and small are the net purchaser of foodgrains and hardly can afford the high input cost for raising a successful non-food cash crop.
- The predominance of foodgrains group together with the fact that a significant proportion of agricultural production is concentrated in small farms, leads one to conclude that much of the cultivation is for self consumption.
- The fact that large areas remains under foodgrains shows that land productivity has not increased at par with technological possibilities.

Despite significant changes in cropping pattern, the shift towards high valued commercial crops has been very small. The result is an insignificant impact on the growth of the crop output.

2.4. Changes in Cropping System in India

The present phase of changes being encountered by the agricultural sector, such as reducing availability of quality water, nutrient deficiency in soils, climate change, farm energy availability, loss of biodiversity, emergence of new pest and diseases, fragmentation of farm lands and changing consumption pattern coupled with new IPRs and trade regulations regimes are resulting in changes in cropping system in India as follows

Increase in cropping intensity

The **cropping intensity is increasing** in India. The cropping intensity in India has increased from **111% in 1950-51 to 151% in 2019-20**, registering an increase of 40% since independence.

> ***Reason:*** *The increase in population has put pressure on land to increase productivity per unit area, unit time and for unit resource used. In response, the cropping system has to evolve to make efficient use of limited available natural resources.*

Cropping intensity

The cropping intensity refers to raising of a number of crops from the same field during one agricultural year. Higher cropping intensity means that a higher proportion of the net sown area is being cropped more than once during one agricultural year. In India, there exists a large variation (<125% to >200%) in regional cropping intensities.

Strategies for raising cropping intensity

- **Clustering of different production areas** is needed and grouping should be done based on key production constraints.
- **Identifying suitable early-maturing field crops** and their agronomic packages. Early maturing varieties are photo-synthetically more efficient, require less water, escape biotic and abiotic stresses and mature earlier.
- **Sequential incorporation of farm yard manure and crop residues** that have many-fold beneficial effects, including improvement of physical condition of and carbon credit to the soil.
- **Choosing at least one leguminous crop in the rotation** offsets the external application of nitrogenous fertilizers.
- **Efficient rainwater management and enhancement of water use efficiency** through the adoption of micro-irrigation systems, such as drip, sprinkler or modified sprinkler systems to offset the impact of changing rainfall patterns and lowering groundwater tables
- **Adopting efficacious insecticides of biological origin** which are environment-friendly and operate with a high degree of insect specificity.

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- **Integrated weed management strategy** involving manual, mechanical and chemical means, and crop rotation can facilitate effective crop intensification.
- **Intensive use of technological advancements** such as precise sowing and weeding tools, spraying drones, mechanically operated harvesters and threshers are indispensable to sustainable crop intensification.

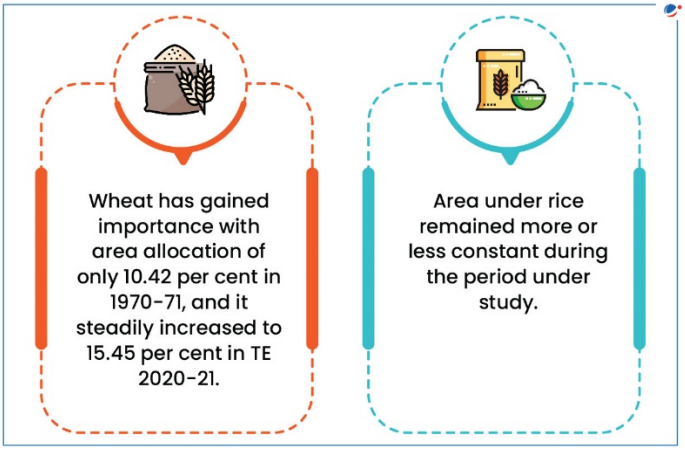
Further, adoption of laser levelling, furrow irrigated raised bed (FIRB) system, incorporation of crop residues to the soil, improved crop geometry, inter- and mixed-cropping with compatible crops, and the like have made it possible to grow successfully two or more crops simultaneously, eventually leading to increased CI and crop's total system productivity.

Systematic intercropping with compatible crop combination has tremendous potential to raise CI up to 400–500% even in rainfed cropping system, which still accounts for 42% of the net cropped area in the country.

Reduction in the dominance of food crops

At the time of Independence, over 80% of the gross cropped area in the country was devoted to the production of food crops. It is remarkable to observe that area under foodgrains in gross cropped area declined to 63.81% in 2020-21, marking a decline of 16%. Thus, demonstrating that predominance of foodgrains is still there but is declining gradually.

Reason: *Gradually with commercialization of agriculture and changes in consumer demand, farmers in India have started shifting area to non-food crops mainly due to relatively better price realization.*



Within a broad group of food crops, cereals like wheat and rice dominate. This is due to better prices, less risk in production and the availability of better seeds.

Enhancement in area under different variety of Crops

Almost every kind of crop is grown in India as it is endowed with a variety of soils. Cash crops have gradually caught up with the production of food crops and more and more farmers are moving from subsistence to commercial farming.

Horticulture crop production: (As per the 2nd advance estimates for 2022-23, the total horticulture production is estimated to be 351.92 Million Tonne, surpassing the total foodgrain production of 329.69 Million Tonne during the year. At present, India is the second largest producer of vegetables and fruits in the world.)

Reason*: The Horticulture production in the country has been steadily increasing over the years due to the* ***proactive policies and initiatives of the Government*** *of India and the State Governments and the improved crop production* ***technologies and management practices.***

- *The increase in awareness of* ***health benefits*** *is also raising the demand of fruits and vegetables.*
- *Besides, medicinal plants, fruits, flowers and vegetables are gradually getting special attention due to their demand in* ***food processing and export potential****.*

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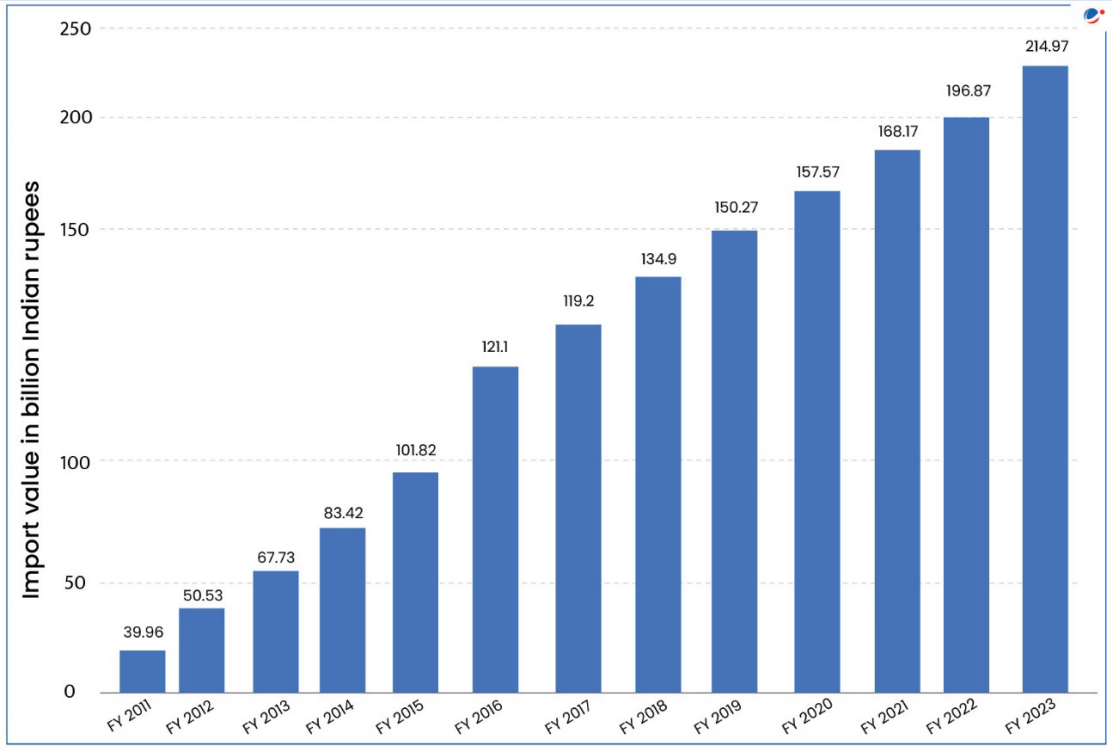
Value of fruits and vegetables imported into India from financial year 2011 to 2023:
With more than a billion people to feed, India ranks second in the production of fruits and vegetables in the world. Despite this, the value of fruit and vegetable imports in the country amounted to over 214 billion Indian rupees in fiscal year 2023. More than 16 percent of the total imports of fruits and vegetables in the country came from China in 2017.



Plantation crops: These are highly profitable but require huge capital and large tracts of land. Thus it is confined to limited parts of the country. Emphasis is placed now on **production of oilseeds** through various initiatives like Integrated Scheme of Oilseeds, Pulses, Maize and Oil Palm (ISOPOM). Share of area under oilseeds has increased from 9.85% in 1970-71 to 13.52% in 2020-21.

> ***Reason:*** *After ensuring food security, now the policy emphasis is on increasing farmers income, boosting exports, and saving foreign exchange spent on import of edible oils.*

Other commercial crops: The area under commercial crops like cotton and sugarcane registered significant increase from 4.70 per cent to 6.55 per cent and from 1.62 per cent to 2.43 per cent during 1970-71 to 2020-21, respectively.

> ***Reason:*** *Assured prices by Cooperatives and Sugar mills for sugarcane and guaranteed price for cotton through the government's monopoly procurement scheme encourage the production of these crops.*

Decline in the importance of certain crops

- **Decline in coarse cereals**

  Jowar, Bajra, Maize, Millets, Barley etc. are called coarse or inferior cereals. The area under these crops has declined significantly from **28.48 per cent in 1970-71 to 11.7% in 2020- 21**. However, yield witnessed a significant rise since fiscal year 2016.

  Reason: This is due to spread of irrigation facilities because it enables the adoption of other water intensive crops, improved inputs and a shift in consumption patterns of the people.

Student Notes:

Increase in cultivation of water intensive crops

India's cropping pattern highlights the rampant cultivation of water intensive crops such as sugarcane production in Maharashtra, paddy in North-West India, which are amongst the water stressed regions of India.

Various reasons behind this trend:

Government's incentive structure: The government's policies for various inputs including subsidies on water, power and fertilizer has promoted farmers to cultivate crops, which are highly water intensive such as paddy and sugarcane. Rice and sugarcane crops together consume more than 60% of water available for irrigation.

Minimum Support Prices (MSPs): Though MSPs are currently announced for 23 crops, the most effective price support is for sugarcane, wheat and rice.

Demand for water intensive crops: Rice is one of the most important staple food crops in India. Similarly, there is large industrial demand for crops like cotton, which push the farmers to grow them as they bring larger profits.

Increased water demand by crops: The new artificially modified HYV seeds have been giving higher crop yields, but they require more water than natural seeds.

Lack of sensitization: There is a lack of awareness among farmers about the strain on natural resources due to water-intensive crops. Mostly, the same cropping pattern keeps continuing over the next generation of farmers.

Now government is focusing on Zero Budget Natural Farming, Conservation Agriculture, Regenerative Agriculture etc.

Changes in cropping system due to climate change

As per a climate change impact assessment, climate change reduces crop yields and lower nutrition quality of produce. For example, in absence of adoption of adaptation measures

- Rainfed rice yields in India are projected to reduce by 20% in 2050 and 47% in 2080 scenarios
- Irrigated rice yields are projected to reduce by 3.5% in 2050 and 5% in 2080 scenarios.
- Climate change is projected to reduce wheat yield by 19.3% in 2050 and 40% in 2080 scenarios towards the end of the century with significant spatial and temporal variations.
- Climate change is projected to reduce the *kharif* maize yields by 18 and 23% in 2050 and 2080 scenarios, respectively.

Thus, cropping system **would be shifted towards crops like soybean, groundnut and chickpea** which would be benefited by climate change.

Changes in pattern due to advancements in technology

There is possibility of increase in area under cultivation of GM crops. India had the world's fifth largest cultivated area under genetically modified (GM) crops, at 11.4 million hectares (mh) in 2017. But unlike other big growers, its entire GM crop area is under a single crop, Bt cotton.

Status of transgenic crops in India

- There is an array of crops — brinjal, tomato, maize, chickpea — in various stages of trials that employ transgenic technology.
- However, cotton remains the only transgenic crop that is being commercially cultivated in India.
- After a long hiatus, the GEAC, the apex technical body charged with evaluating proposals for testing genetically modified (GM) seeds, approved the environmental release of Mustard hybrid DMH-11 and its parental lines in 2022 for seed production and testing. This is one step away from full commercial cultivation.

Arguments in favor of GM crops:

- **Food security**: GM crops have high productivity and are thereby vital for ensuring food security to the rising population. It will also reduce dependence on imports e.g. import of cooking oil.
- **Lower costs of production:**
  - **Lesser consumption of pesticides and insecticides**: GM food crops have stronger resistance to diseases. For instance, **the success of the Bt cotton technology** also ensured resistance to **the bollworm**, which led to improved agronomic practices and use of novel pesticide molecules for control of other pests.
  - GM crops are estimated to have increased agricultural production by nearly $100 billion and prevented nearly 500 million kg of pesticides from being sprayed since the technology was first commercialized nearly two decades ago.
  - Less labor needed in procedures like weeding etc.
- **Higher yield and shorter duration**: GM crops have shorter growing cycles, and produce higher yields, thus yielding higher incomes.
- **Safety**: According to various studies by independent agencies, GM foods have passed safety assessments and are unlikely to pose risks to human health.
- **Growth in industry and exports**: Increased production of crops could provide further benefits to industries such as the food processing industry. This will also provide opportunities for increased export.

Arguments against GM crops:

- **Public health and safety**: It is argued that GM crops may have carcinogenic effects. According to the WHO, GM crops may provoke allergic reactions and gene transfer. Gene transfer from GM foods to cells of the body in the gastrointestinal tract may adversely affect human health.
- **Threats to biodiversity**: It is believed that if GM foods are mixed with non-GM crops, there may be threats to **ecological balance and biodiversity**, which can have an indirect effect on food safety and food security.
- **Field trials and testing:** Field trials of GM crops are not adequately and appropriately supervised. In a paper by M.S. Swaminathan, it was reported that **the precautionary principle (PP)** has been done away with and no science-based and **rigorous biosafety protocols and evaluation of GM crops are in place**.
- **Lack of regulation and illegal imports:** Lack of regulation leads to illegal varieties of GM crops being imported. For instance, many environmentalists argue that illegal Bt cotton, HT cotton cultivation and other illegal imports of GM foods are taking place.
- **Livelihood security:** Critics argue that GM crops have failed to protect small and marginal farmers.

Alternative improved cropping systems

Several, new cropping systems are coming up in the different agro-climatic regions after inclusion of high value crops and their high yielding varieties which are disease resistant in the cropping sequences.

- These alternative improved cropping systems are proven more and more remunerative than existing cropping systems.
- The yield potential of alternative cropping systems was high across the different agro-climatic zones of the country due to inclusion of new crops and high yield varieties which are most suitable to those climatic conditions, soil and other production factors.
- The average yield potential of existing cropping systems ranges between 4.1–13.7 t/ha/year but after adopting alternate cropping, the yield potential can be increased in the tune of 5.0–30.1 t/ha/year

It is a non-monetary input for crop production, simple farmers have to be awared about the new crops and their varieties which are suitable to their area.

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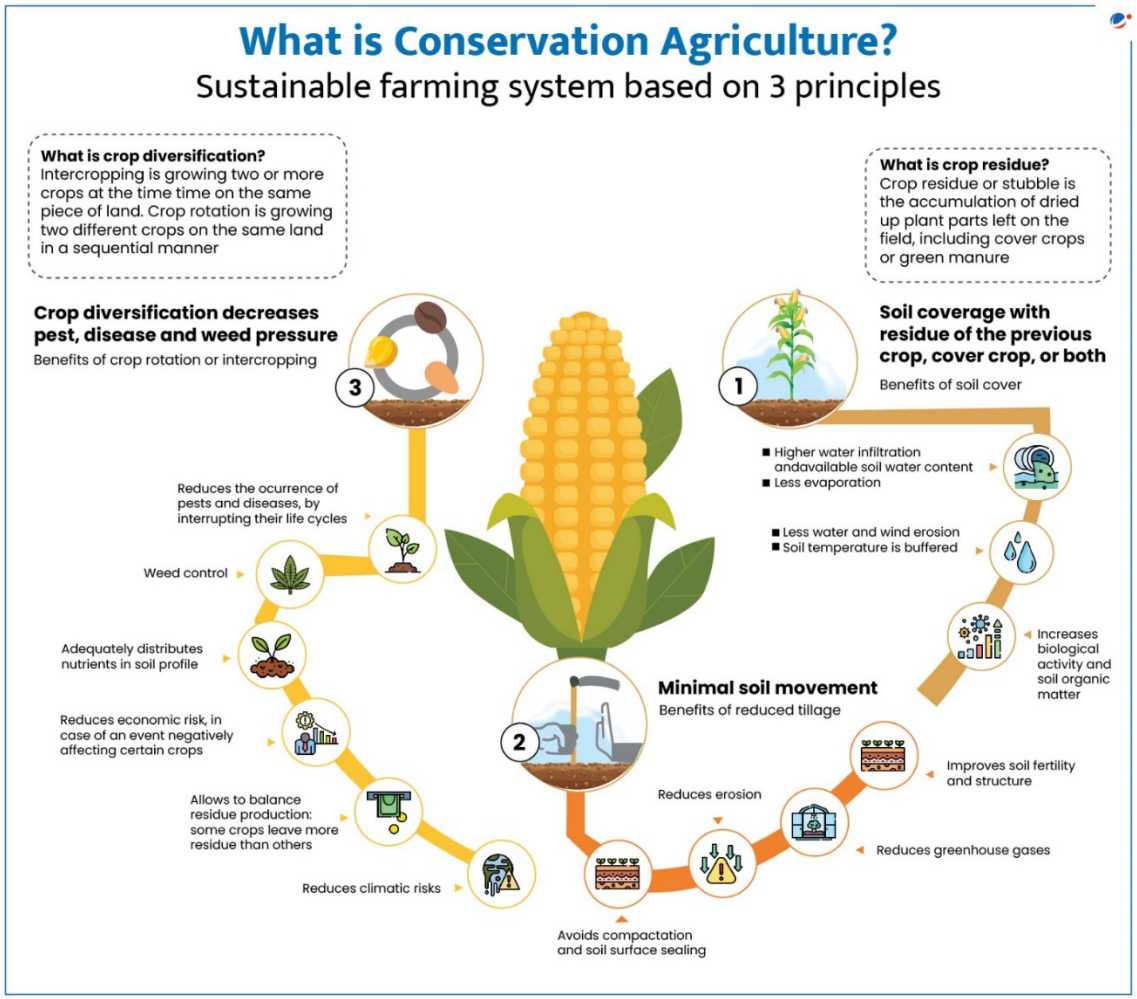
3. Miscellaneous

3.1. Conservation Agriculture

Conservation Agriculture (CA) is a farming system that can prevent losses of arable land while regenerating degraded lands. It promotes maintenance of a permanent soil cover, minimum soil disturbance, and diversification of plant species.

- It **conserves natural resources, biodiversity and labor**. It increases available soil water, reduces heat and drought stress, and builds up soil health in the longer term
- To reduce soil disturbance, farmers practice **zero-tillage farming**, which allows direct planting without plowing or preparing the soil. The farmer seeds directly through surface residues of the previous crop.
- **Zero tillage is combined with intercropping and crop rotation**, which means either growing two or more crops at the same time on the same piece of land, or growing two different crops on the same land in a sequential manner. These are also core principles of sustainable intensification.



3.1.1. Conservation agriculture and Climate-smart agriculture

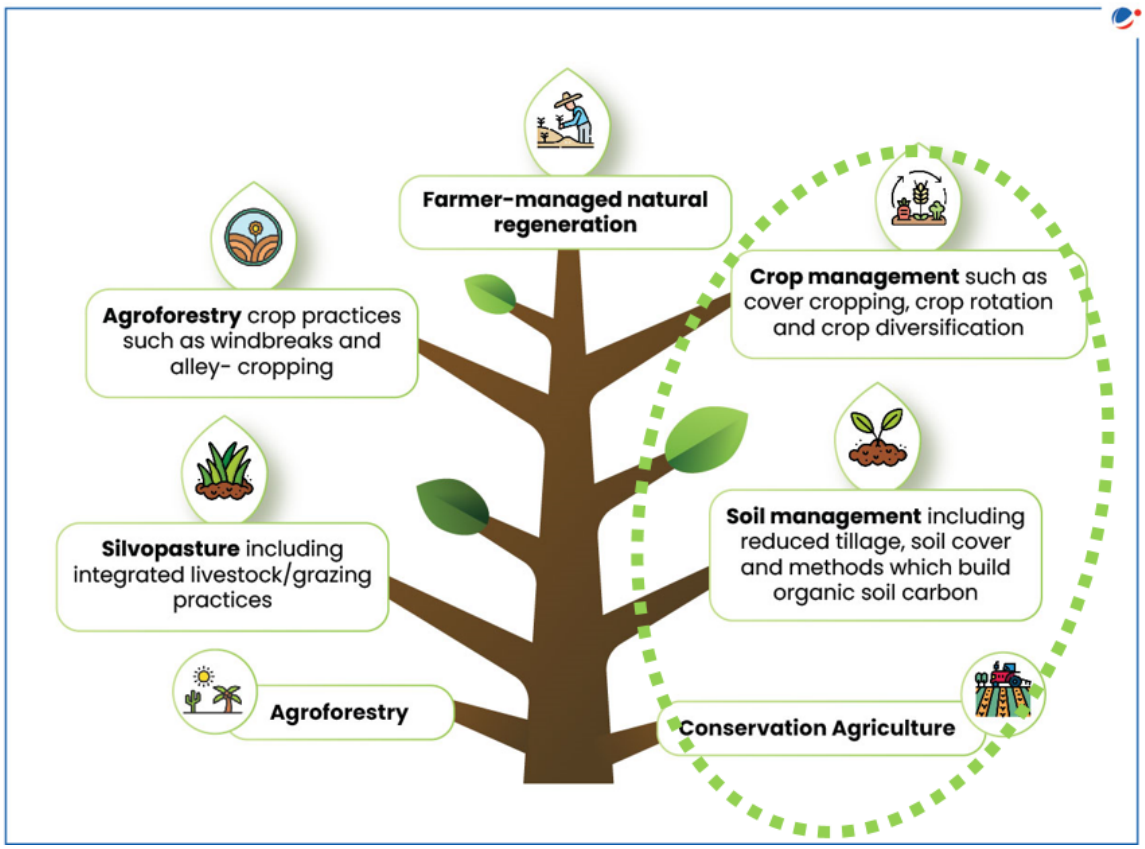
- While conservation agriculture and climate-smart agriculture are similar, their purposes are different. Conservation agriculture aims to sustainably intensify smallholder farming systems and have a positive effect on the environment using natural processes. It helps farmers to adapt to and increase profits in spite of climate risks.
- Climate-smart agriculture aims to adapt to and mitigate the effects of climate change by sequestering soil carbon and reducing greenhouse gas emissions, and finally increase

productivity and profitability of farming systems to ensure farmers' livelihoods and food security in a changing climate. Conservation agriculture systems can be considered climate-smart as they deliver on the objectives of climate-smart agriculture.

3.1.2. Is conservation agriculture organic?

- Conservation agriculture and organic farming both maintain a balance between agriculture and resources, use crop rotation, and protect the soil's organic matter.
- However, the main difference between these two types of farming is that organic farmers use a plow or soil tillage, while farmers who practice conservation agriculture use natural principles and do not till the soil. Organic farmers apply tillage to remove weeds without using inorganic fertilizers.
- Conservation agriculture farmers, on the other hand, use a permanent soil cover and plant seeds through this layer. They may initially use inorganic fertilizers to manage weeds, especially in soils with low fertility. Over time, the use of agrichemicals may be reduced or slowly phased out.

3.1.3. Conservation agriculture and agroforestry



3.2. Regenerative Agriculture

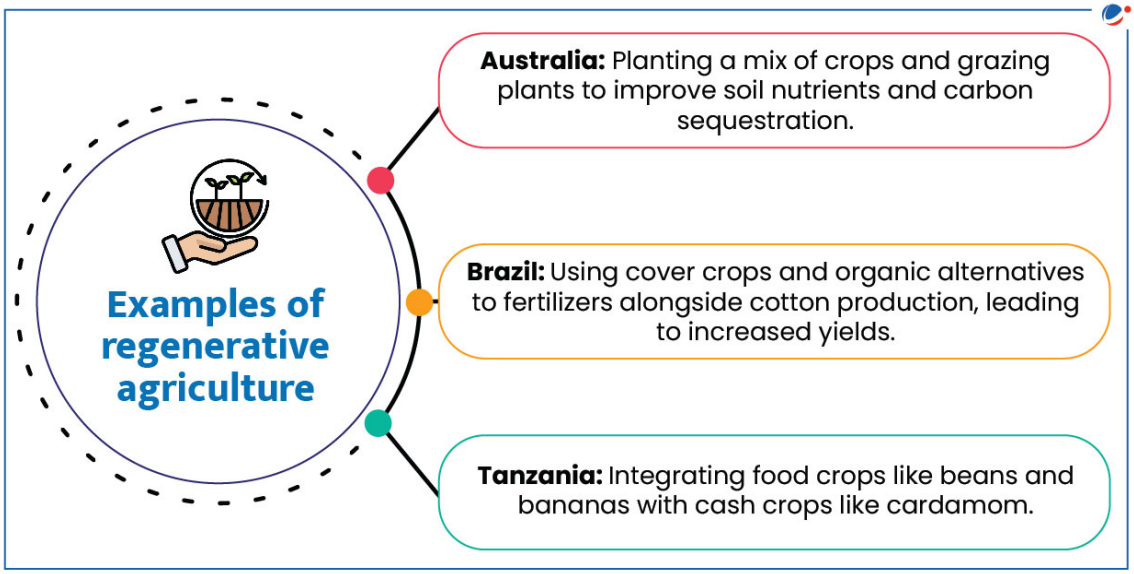
Regenerative agriculture is a holistic farming system that focuses on soil health, food quality, biodiversity improvement, water quality and air quality.

The current intensive agriculture system has led to soil degradation and constant losses. There may not be enough soil to feed the world in next 50 years. Soil fertility and biodiversity are decreasing across the globe. It is necessary to regenerate soil on more than four billion acres of cultivated farmland to feed the world, keep global warming below 2 degrees Celsius and stop biodiversity loss.

Student Notes:

Benefits of regenerative agriculture

- It **improves soil health** through practices that increase soil organic matter, biota and biodiversity. It also aims at enhancing water-holding capacity and carbon sequestration.
- Regenerative agriculture **supports biodiversity** and returns carbon and nutrients to the soil. Biodiversity is the prime driver of soil carbon sequestration and other ecosystem benefits. Soil organic carbon and soil organic matter are vital for plant growth.
- It facilitates **soil aggregation, water infiltration, retention and nutrient cycling**. Regenerative agriculture also reduces erosion, provides habitat and food for diverse species and is beyond sustainability.



3.3. Green Revolution – Krishonnati Yojana

Objective

To develop the agriculture and allied sector in a holistic and scientific manner to increase the income of farmers by enhancing production, productivity and better returns on produce.

Salient Features

It is a Centrally Sponsored Umbrella Scheme that has been implemented since 2016-17. It comprises of 11 schemes / missions:

- **Mission for Integrated Development of Horticulture (MIDH)-** to promote holistic growth of the horticulture sector.
- **National Food Security Mission (NFSM) including National Mission on Oil Seeds and Oil Palm (NMOOP)-** to increase production of rice, wheat, pulses, coarse cereals, oilseeds and commercial crops through area expansion, restoring soil fertility and improving productivity.
- **National Mission for Sustainable Agriculture (NMSA)-** to promote sustainable agriculture practices focusing on integrated farming, appropriate soil health management and synergizing resource conservation technology.
- **Sub-Mission on Agriculture Extension (SMAE)-** to strengthen ongoing programmes of states/local bodies to achieve food security, empower farmers, strengthen programme planning, ICT usage etc.
- **Sub-Mission on Seeds and Planting Material (SMSP)-** to increase production of certified / quality seed, increase seed replacement rate (SRR) and upgrade the quality of farm saved seeds.

Student Notes:

- **Sub-Mission on Agricultural Mechanization (SMAM)-** to increase the reach of farm mechanization, promote 'Custom Hiring Centres' to offset the adverse economies of scale arising due to small landholding and high cost.
- **Sub-Mission on Plant Protection and Plan Quarantine-** to minimize loss to quality and yield of agricultural crops, shield agricultural biosecurity, facilitate exports and promote good agricultural practices.
- **Integrated Scheme on Agriculture Census, Economics and Statistics**- to undertake the agriculture census, study the cost of cultivation of principal crops, to undertake research studies on agro-economic problems etc.
- **Integrated Scheme on Agricultural Cooperation (ISAC)-** to provide financial assistance for improving the economic conditions of cooperatives, removing regional imbalances.
- **Integrated Scheme on Agricultural Marketing (ISAM)-** to develop and provide agricultural marketing infrastructure, promote innovative and latest technologies and integrate markets through a common online market platform.
- **National e-Governance Plan (NeGP-A)-** to improve access of farmers to information & services, making available timely and relevant information to the farmers for increasing their agriculture productivity.

3.4. Bringing Green Revolution to Eastern India (BGREI)

The program was launched in 2010-11 to address constraints limiting the productivity of "rice based cropping system" in eastern India comprising seven states – Assam, Bihar, Chhattisgarh, Jharkhand, Orissa, Eastern Uttar Pradesh (Purvanchal) and West Bengal.

Various initiatives under the scheme are –

- Block or cluster development of improved production technology.
- Asset building activities for farm improvement.
- Site specific activities for farm renovation.
- Seed production and distribution.
- Marketing support and post-harvest management.

Objectives

- To increase production and productivity of rice and wheat by adopting latest crop production technologies.
- To promote cultivation in rice fallow area to increase cropping intensity & income of the farmers.
- To create water harvesting structures and efficient utilization of water potential.
- To promote post-harvest technology and marketing support.

3.5. Operation Greens

Operation Greens was announced in the Budget speech of 2018-19 with an outlay of Rs 500 crores to stabilize the supply of Tomato, Onion and Potato (TOP) crops and to ensure availability of TOP crops throughout the country round the year without price volatility.

Major objectives of "Operation Greens"

- Enhancing value realisation of TOP farmers by targeted interventions to **strengthen TOP production clusters** and their Farmer Producers Organizations (FPOs), and linking/connecting them with the market.
- **Price stabilization** for producers and consumers by proper production planning in the TOP clusters and introduction of dual use varieties.
- **Reduction in post-harvest losses** by creation of farm gate infrastructure, development of suitable agro- logistics, creation of appropriate storage capacity linking consumption centres to increase shell life.

Student Notes:

- **Increase in food processing capacities** and value addition in TOP value chain with firm linkages with production clusters.
- **Setting up of a market intelligence network** to collect and collate real time data on demand and supply and price of TOP crops.

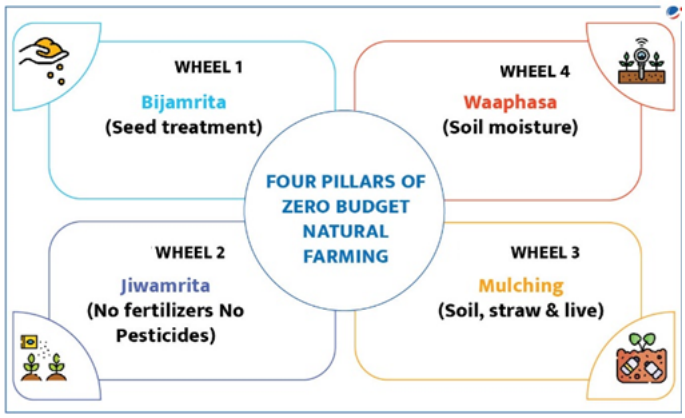
3.6. Zero Budget Natural Farming (ZBNF)

It is a natural farming technique, developed by **Subhash Palekar**, in which farming is done without use of chemicals and without using any credits or spending any money on purchased inputs.

ZBNF reduces the cost of production down to zero due to utilisation of all the natural resources available in and around the crops. Farmers use earthworms, cow dung, urine, plants, human excreta and other biological fertilizers for crop protection.

Features of ZBNF

- **Seed treatment**: The seeds are treated with formulations prepared using cow dung and cow urine from native cow species as they have higher adaptability to our local climatic conditions and easy to maintain by the small and marginal farmers.
    - The seeds sown in the field may be affected by fungus and other seed born/soil born diseases. However, the seed treatment using "Bijamrita " protects the seeds from diseases.
- **Use of Bio-Fertilizers and elimination of chemical fertilizers and pesticides** – Farmers have a practice named Jiwamrita in which they apply fertilizers made of local cow dung and cow urine. Furthe, extracts of neem leaves and pulp, tobacco and green chillies are used for insect and pest management.



- **Utilization of soil moisture**: Farmers of drought-prone areas adopt mulching and Waaphasa to reduce the loss of natural moisture of the soil, increase soil aeration, enhance soil health and fertility and ensure favorable microclimate in the soil.

Other critical elements of ZBNF

- **Intercropping –** The practice of growing monocot and dicot crops on the same field compensates for the cost incurred on the main crop, ensuring a regular flow of income for the farmers.
- **Contours and bunds** – To preserve rainwater, the construction of the contours and bunds is undertaken.
- **Local species of earthworms –** ZBNF supports the revival of local deep soil earthworms through increased organic matter.
- **Cow dung** - ZBNF revolves around Desi cow; dung from the Bos-indicus (humped cow/ desi) is considered most beneficial and has the highest concentrations of micro-organisms as compared to European breed of cows such as Holstein.

Why ZBNF ?

- **Reduce expenditure and increasing farmer income**: National Sample Survey Office (NSSO) data indicates that more than 70 % of the agricultural households spend more than they earn and more than 50 per cent of all farmers are in debt due to increased cost of farm inputs like fertilizers and chemical pesticides. ZBNF helps reduce the dependence of the farmers on external inputs like chemical fertilizers and pesticides, which they cannot afford.

Student Notes:

- **Water conservation**: ZBNF also includes replenishing water bodies such as farm ponds to ensure water availability during dry spells.
- **Soil quality**: Farmers also practice replenishing local species of earthworms on the farm to increase the organic matter in the soil which in-turn increases soil's capacity to retain moisture.

4. Previous Years UPSC Mains Questions

1. What are the major reasons for declining rice and wheat yield in the cropping system? How crop diversification is helpful to stabilize the yield of the crop in the system?
2. How has the emphasis on certain crops brought about changes in cropping patterns in the recent past? Elaborate the emphasis on millets production and consumption.
3. How do subsidies affect the cropping pattern, crop diversity and economy of farmers? What is the significance of crop insurance, minimum support price and food processing for small and marginal farmers?
4. Explain the changes in cropping patterns in India in the context of changes in consumption patterns and marketing conditions. (15 Marks, 250 Words)
5. What are the major factors responsible for making the rice-wheat system a success? In spite of this success, how has this system become a bane in India? (250 words, 15 Marks)

5. Previous Years Vision IAS GS Mains Questions

1. The decision to grow a particular crop by a farmer is affected by various factors other than the yield of a crop. Discuss this statement and assess the need for bringing a change in the cropping pattern in India.

Approach:

- Briefly write about the concept of cropping pattern.
- Write about various factors which affect the decision of a farmer to grow a particular crop.
- Explain why the present cropping pattern in India needs to be changed.
- Conclude accordingly.

Answer:

Cropping pattern is the proportion of area under different crops at a point of time. It changes over space and time. A strong factor in deciding which crop to grow is the **yield** which is defined as tonnes of crop produced per hectare area in which the crop was sown. **Higher the yield** per unit area, **higher will be returns** on investment of time and money.

Apart from yield, several other factors influence cropping pattern:

- **Physical factors:** Cropping pattern depends on climate, terrain, topography, slope, temperature, amount and reliability of rainfall. For example, in rainfall deficient areas of Rajasthan, farmers grow bajra, while in Brahmaputra valley of Assam rice is the dominant crop.
- **Soil type:** Cotton is grown in regur (black earth) soil of Maharashtra and Gujarat, while the loamy soils of western Uttar Pradesh, Haryana and Punjab are ideally suited for wheat, rice and sugarcane.
- **Irrigation facilities:** Wherever water is available, not only can a water guzzling crop be grown but even double or triple cropping will be possible.
- **Availability of Inputs:** Seeds, fertilizers, water storage, marketing, transport etc. also affect the cropping pattern.
- **Government Policies:** The legislative and administrative policies of the government may also affect the cropping pattern. These may include procurement policies, subsidies, MSPs, export policies etc. MSPs for some crops such as wheat and rice

have remained high in comparison to millets. As a result, intercrop price disparities lead to shifts in acreage between the crops.

- **Institutional factors:** Such as **land tenancy, ownership of land and size of holdings** also impose restrictions on the cropping patterns of a region.

Need for changing existing cropping pattern:

- **Monocropping:** There is **imbalance in the cropping pattern of the food grains.** A large proportion of the area under food grains is occupied by rice and wheat.
- **Nutrient deficiency:** Owing to **changes in the consumption patterns,** people have moved from nutrient-rich coarse cereals to wheat and rice as their main dietary grain.
- **Income Support:** As a result of procurement at MSP, there has been a **constant increase in the production of rice and wheat with little emphasis on other cereals**.
- **Water-scarcity:** Cultivation of **crops unsuitable to agro-climatic zones.** For instance, there has been increasing practice of growing water intensive crops like rice in regions of low ground water levels like Rajasthan.
  - Of the cereals grown in India, rice consumes the most water per tonne of output while delivering the least nutrients like iron, zinc and protein.
  - India could reduce the water it uses for irrigation by a third, and simultaneously address its persistent malnutrition problem, if it replaced its rice crop with more nutritious and less thirsty cereals.
- **Need of second Green Revolution:** Increased use of water for irrigation and indiscriminate use of pesticides and fertilisers for HYV seeds has led to soil salinisation, water pollution and reduction in soil fertility. This requires a new Green Revolution.

Thus, the existing cropping pattern is inefficient and unsustainable necessitating the need to move away from the present rice-wheat dominant cropping pattern.

Student Notes:

2. Explain how climate change and resultant extreme weather events are impacting the cropping patterns in various parts of India.

Approach:

- Briefly write about the impact of climate change on agriculture.
- Explain the impact of climate change on cropping patterns in India.
- Conclude accordingly.

Answer:

Climate is the most important determinant of crop productivity, particularly in countries like India, where the majority of cultivated area is rainfed. Climate change, therefore, is of serious concern having large-scale direct and indirect impact on agriculture in India.

The climate change and resultant extreme weather events are impacting cropping patterns in various parts of India in the following manner:

- **Shifting from kharif to rabi crops due to flooding:** Due to increase in flooding, farmers are changing the crops.
  - *For example, in **Assam's Dhemaji district**, farmers are cultivating more **Rabi crops**, such as mustard, potatoes and peas, **rather than Kharif crops**, such as rice.*
- **Early harvest due to rising temperatures:** Rising temperatures are forcing the farmers, especially in North India, to change harvesting season.
  - *For example, in 2023, for the first time, **mustard was harvested in February instead of late March or April** month.*
- **Moving to higher altitudes:** The increasing winter temperatures have impacted the farming activities in the **Himalayan region**.
  - ***For example**, farmers in Himachal Pradesh have either **shifted apple production to higher altitudes** or **intercropped** vegetables and fruits in lower altitudes*.
- **Shifting to aquaculture:** In coastal areas, farmers are aligning crop and livestock production to changing ecosystems and natural resources.
  - *For example, in **south Gujarat**, many farmers have shifted **from agriculture to aquaculture** as the saltwater ingress in fertile soil made it impossible for them to continue agriculture.*
- **Adopting less water intensive crops:** Changes in precipitation patterns and increased evaporation is leading to water scarcity, especially in drought prone areas.
  - *For example, in **Maharashtra**, farmers in drought-prone regions have **shifted** to **pomegranates from grapes**.*
- **Adopting new techniques due to extreme weather:** Farmers have started adopting new technologies that impact the existing agricultural production in significant ways.
  - *For example, **use of regular and storm-resistant greenhouses** in India is on the rise.*

Considering the widespread impact of climate change on cropping patterns, appropriate adaptation strategies have to be developed to make agriculture sustainable and climate-resilient. The government has taken various initiatives in this regard such as ***National Mission for Sustainable Agriculture (NMSA), National Innovations in Climate Resilient Agriculture' (NICRA),*** *etc.*

Student Notes:

3. Despite pulses providing dual benefits of nutritional security and sustaining agricultural production systems, India has not been able to achieve self-sufficiency in their production. Discuss.

Approach:

- In introduction, briefly highlight the dual benefits obtained from pulses.
- Then discuss why India has not been able to achieve self-sufficiency in their production.
- Mention the initiatives taken by the government in this regard.
- Conclude accordingly.

Answer:

India is the largest producer (25%), largest consumer (27%) and largest importer (14%) of pulses in the world. Pulses are a category of superfoods that includes chickpeas, lentils, dry peas and beans.

Pulses are instrumental in providing nutritional security and sustaining agriculture production systems:

- It is the main source of **protein** and **vitamins** for developing countries like India. As due to low per capita income, people cannot afford various other costlier sources of nutrients.
- Protein forms a significant part of the **government's dietary allowance** to children, adolescent girls and pregnant and lactating women. Pulses play a very crucial role in meeting up the objective.
- Pulses require **less water than other protein sources** and could be planted on small plots of land. Short duration facilitates growing a second crop on the same land.
- It helps to **fix atmospheric nitrogen and add organic matter** to the soil thus fertility of soil remains intact.

India's estimated demand for pulses was 26.5 million tonnes in 2018-19 and is estimated to be around 39 million tonnes by 2050. However, despite such favorable conditions, India has not been able to achieve self-sufficiency in their production owing to various challenges:

- **Input related challenges**: Non-availability of location specific/recommended HYVs quality certified seeds and inability of farmers to access institutional credit discourage them to purchase quality inputs and adopt improved technology.
- **Production related challenges:** Pulses are prone to numerous biotic and abiotic stresses, soil alkalinity, salinity, waterlogging etc. Crop failure occurs due to reasons like erratic monsoon behaviour and moisture stress.
- **Cultivation on marginalized lands**: Green revolution pushed pulses cultivation in marginal and sub-marginal lands resulting in declining productivity. Around 84% area under pulses is rain-fed with low fertility soils.
- **Ineffectiveness of MSP**: Though Minimum Support Prices are announced for 23 commodities, substantial benefits accrue to wheat and rice growers in selected States leaving pulse-growers often receiving prices much below MSP. Lack of assured markets make pulse production less attractive for farmers compared to other crops.
- **Lack of post-harvest infrastructure**: There is lack of infrastructure for scientific storage and related activities, like standardization, grading, packaging and insurance services for the pulses sector.

The government has taken various steps to address these issues. It has come up with **Integrated Schemes of Oilseeds, Pulses, Oil palm and Maize or ISOPOM**, Accelerated Pulses Production Program (A3P) and Pulses development scheme. Recently, the

Student Notes:

Government has also come up with a detailed plan for both **area expansion and productivity enhancement for Tur, Moong and Urad**. However, it is important to ensure on time availability of **high-yielding**, short duration varieties as well as easy access to **production technologies**.

4. The current state of millet production in India leaves much to be desired despite the numerous advantages of cultivating millets. Discuss the major factors for low adoption of millet cultivation by the Indian farmers.

Approach:

- Introduce by mentioning the current status of millet production in India.
- Briefly mention the advantages of cultivating millets.
- Discuss the major factors for lower adoption of millet cultivation by Indian farmers.
- Conclude appropriately.

Answer:

While millets made up around **40% of India's all cultivated grains** before the Green Revolution, it has **dropped to around 20%** over the years.

Millets are **nutritionally rich** with a high fibre to carbohydrate ratio and rich mineral content. Their consumption helps manage diabetes and obesity. They are **climate-resilient** crops, can be grown in water-scarce conditions and have a good ability to **sequester carbon**.

Despite the benefits, the low adoption of millet cultivation is due to the factors given below:

- **Low demand**: Consumption of millets has seen a decline due to factors like high duration requirements for cooking millets, lack of value-added millet-based products, lack of traditional knowledge to prepare millets-based recipes etc.
    - *For example, **per capita consumption** of millets fell drastically from **32.9 kg to 3.87 kg** from **1962 to 2022**.*
- **Low productivity**: The average millet productivity is **1 to 1.5 tonnes per hectare,** which is much lower than rice and wheat. This results in low profitability and pushes the cultivation of millets to marginal lands with further lower productivity potential.
- **Low-quality seeds:** The seeds available are often of inferior quality or contaminated with weeds or disease, which makes it difficult for farmers to get the desired yield.
- **Inadequate government procurement**: The abysmally low level of procurement is the main reason for the continuous reduction of area under millets.
    - *For example, at present, government procurement of **pearl millet, sorghum and finger millet is only 1%, 3% and 15% respectively** of their total domestic production, as compared to 45 to 70% for wheat and rice.*

- **Lower shelf life:** Millets get pest infestation during storage and thus have a shorter shelf life. Thus, to cover the losses, they are sold at higher prices leading to low affordability and low demand.
- **Lack of a robust supply chain for millets:** The majority of millet producers in India are small-scale farmers who lack access to modern technology, credit facilities, and storage infrastructure. As a result, they struggle to meet the quality and quantity demands of larger markets.

Considering the challenges, research and development for yield improvement, modern processing methods, pest control, adequate government procurement and market support can push the adoption of millet cultivation by Indian farmers.

Student Notes:

Heartiest Congratulations
to all Successful Candidates

Aditya Srivastava

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