

AGRICULTURE

Agricultural Sector is the mainstay of the rural Indian economy around which socio-economic privileges and deprivations revolve and any change in its structure is likely to have a corresponding impact on the existing pattern of social equity.

According to the new series of national income released by the CSO, at 2011-12 prices the share of agriculture in total GDP is 18 per cent in 2013-14. As against a growth target of 4 per cent for agriculture and allied sectors in the Twelfth Plan, the growth registered in the first year at 2011-12 prices was 1.2 per cent, 3.7 per cent in 2013-14, and 1.1 per cent in 2014-15.

Role of Agriculture in Indian Economy

- a) The billion-plus-people will continue to depend for their food, as in the past, on agriculture.
- b) Because of comparative advantage, India produces the agricultural products cheaply.
- c) The variety of agro-climatic regions enable India to produce infinite variety of agricultural products.
- d) Agriculture supplies raw materials for different agro-industries like textile, (cotton, woollen, jute or silk) sugar, food processing, vanaspati leather, etc. which dominate the industrial landscape.
- e) Agriculture creates demand for several industrial products like tractors, pumping sets, threshers, chemical fertilizers, pesticides etc.
- f) The prosperity of the industrial sector is highly dependent on the productivity in agriculture.

Types of farming

A. Dryland farming:

- *Dry land areas may be characterized by the following features:*
- a) Uncertain, ill-distributed and limited annual rainfall.

- b) Occurrence of extensive climatic hazards like draught, flood, etc.
- c) Undulating soil surface.
- d) Occurrence of extensive and large holdings.
- e) Practice of extensive agriculture, i.e., prevalence of mono-cropping etc.

• *Problems of dry land farming in India:*

- a) Uncertain and scarce rainfall make the region susceptible to draught and famine.
- b) The soil here is sandy which lacks nutrient materials for soil fertility. Besides the area is prone to soil erosion.
- c) The productivity is low and the crops are more susceptible to pests and diseases.
- d) These areas lack basic infrastructural facilities like market, transport, storage, refrigeration, etc., hence farmers do not get remunerative prices.

• *Strategies for the development of dryland areas :*

- a) Bunding across the slope and leveling the land should be done before onset of monsoon.
- b) Draught resistant varieties of crops should be developed and popularized in these areas.
- c) Crop rotation should be followed which should preferably have at least one legume every year. Inter-cropping of oil seeds and pulses should be done with jowar, bajra and maize crops.
- d) The sowing period and variety of crops should be decided on the basis of arrival, duration and amount of rainfall.

B. Organic farming:

- As per United States Department of Agriculture (USDA), organic farming is a system which avoids or largely excludes the use of synthetic inputs (such as fertilizers, pesticides, hormones, feed additive,s etc) and feasibly rely upon crop

rotations, crop residues, animal manures, off-farm organic waste, mineral grade rock additives and biological system of nutrient mobilization and plant protection.

- **The key characteristics of organic farming**
- a) Protecting the long term fertility of soils by maintaining organic matter levels.
- b) Providing crop nutrients indirectly using relatively insoluble nutrient sources.
- c) Nitrogen self-sufficiency through the use of legumes and biological nitrogen fixation.
- d) Weed, disease and pest control relying primarily on crop rotations, natural predators.
- e) The extensive management of livestock, paying full regard to their evolutionary adaptations.
- f) Careful attention to the impact of the farming system on the wider environment and the conservation of wildlife and natural habitats.

Cropping Seasons of India

Different cropping seasons are discussed below:

a) Kharif Season

- Sown in the beginning of the south west monsoon and harvested at the end of the south west monsoon.
- **Sowing season:** May to July
- **Harvesting season:** September to October
- **Important crops:** Jowar, bajra, rice, maize, cotton, groundnut, jute, sugarcane etc.
- **Some of the most important kharif regions:** Assam, West Bengal, coastal Regions of Orissa, the Konkan coast, Uttar Pradesh and Bihar.

b) Rabi Season

- **Sowing season:** October to December
- **Harvesting season:** February to April
- **Important crops:** Wheat, barley, gram, linseed, peas, potatoes etc.
- **Some of the most important rabi regions:** Northern and north-western states such as Punjab, Haryana, Himachal Pradesh, Jammu and Kashmir, Uttarakhand and Uttar Pradesh.
- Success of Rabi crops depend on the availability of precipitation during winter months due to the

western temperate cyclones. However, the success of the green revolution in Punjab, Haryana, western Uttar Pradesh and parts of Rajasthan has also been an important factor in the growth of the above-mentioned rabi crops.

c) Zaid Kharif

- **Sowing season:** August–September
- **Harvesting season:** December–January
- **Important crops:** Cotton, rapeseed, oilseed jawar etc.

d) Zaid Rabi

- **Sowing season:** February and March
- **Harvesting season:** April and May
- **Important crops:** Watermelon, cucumber, leafy and other vegetables.

Cropping Pattern in India

- Cropping Pattern is the acreage distribution of different crops in any one year in a given farm area such as a county, water agency, or farm. Thus, a change in a cropping pattern from one year to the next can occur by changing the relative acreage of existing crops, and/or by introducing new crops, and/or by cropping existing crops.
- **Factors affecting cropping pattern:**
 - a) Geographical factors like soil moisture temperature, etc. determine the suitability of an area to grow particular crops.
 - b) However, area actually devoted to a particular will be determined by socio-economic factors like dietary habits, land leveling cost of cultivation, capacity of farmer's diffusion of innovation, etc.
 - c) Besides in any locality, the prevalent cropping systems are the cumulative results of past and present decisions by individuals, communities or governments and their agencies. These decisions are usually based on experience, tradition, expected profit, personal preferences and resources, social and political pressures and so on.
 - d) The climatic, edaphic and socio-economic diversity of the Indian crop-production scene is dotted with many cropping patterns.
 - e) Socio-economically, the peasantry ranges from the relatively affluent Punjabi farmers who operate

with a high input intensity in agriculture to the subsistent farmers of eastern and central India.

• **Changes in Cropping Patterns:**

With the advent of modern agricultural technology there is a continuous surge for diversified agriculture in terms of crops, primarily on economic considerations. The crop pattern changes due to:

- a) Resource related factors covering irrigation, rainfall and soil fertility.
- b) Technology related factors covering not only seed, fertilizer, and water technologies but also those related to marketing, storage and processing.
- c) Household related factors covering food and fodder self-sufficiency requirement as well as investment capacity.
- d) Price related factors covering output and input prices as well as trade policies and other economic policies that affect these prices either directly or indirectly.
- e) Institutional and infrastructure related factors covering farm size and tenancy arrangements, research, extension and marketing systems and government regulatory policies.

Agro-Climate Regions

1. **Western Himalayan Region:** Ladakh, Kashmir, Punjab, Jammu etc. Brown soils & silty loam, steep slopes.
2. **Eastern Himalayan Region:** Arunachal Pradesh, Sikkim and Darjeeling. Manipur etc. High rainfall and high forest covers heavy soil erosion.
3. **Lower Gangatic plants Regions:** West Bengal. Soils mostly alluvial are prone to floods.
4. **Middle Gangatic plans Region:** Bihar, Uttar Pradesh. High rainfall, 39% irrigation, cropping intensity 142%.
5. **Upper Gangatic Plains Region:** North region of U.P. (32 districts). Irrigated by canal & tube wells good ground water.
6. **Trans Gangatic plains Region:** Punjab, Haryana Union territory of Delhi, Highest sown area and highly irrigated.
7. **Eastern Plateaus & Hills Region:** Chota Nagpur, Garhjat hills, M.P, W. Banghelkhand plateau, Orissa. Soils shallow to medium sloppy, undulating Irrigation tank & tube wells.

8. **Central Plateau & hills Region:** Madhya Pradesh
9. **Western Plateau & hills Region:** Sahyadry. M.P. Rainfall 904 mm, Sown area 65%, forest 11%, irrigation 12.4%.
10. **Southern Plateau & Hills Region:** Tamil Nadu, Andhra Pradesh, Karnataka. Typically semi and zone, Dry land farming 81%, cropping Intensity 11%.
11. **East coast plains & Hills Region:** Tamil Nadu, Andhra Pradesh, Orissa, Soils, alluvial, coastal sand.
12. **West coast plains & Hills Region:** Sourashtra, Maharashtra, Goa, Karnataka, T. Nadu. Variety of cropping pattern, rainfall & soil types.
13. **Gujarat plains & Hills Region:** Gujarat (19 districts). Low rainfall arid zone. Irrigation 32% well and tube wells.
14. **Western Dry Region:** Rajasthan (9 districts) Hot. Sandy desert, rainfall erratic, high evaporation. scanty vegetation, famine, draughts.
15. **The Island Region:** Eastern Andaman, Nicobar, Western Lakshdweep. Typical equatorial, rainfall 3000 mm (9 months) forest zone undulating.

Crop Productivity: features

Rice

- Rice covers about 23% of gross cropped area.
- **Climatic Conditions-** Rainfall more than 125 cm., clayey loam is best, tolerate acidic as well as alkali soil, average monthly temperature should not fall below 21°C as in Orissa, West Bengal, Bihar, Assam & South India.
- **Area-** Coastal India (south of Bombay in the western coast), eastern India, Chattisgarh plain, Wainganga valley, alluvial plain of West Bengal, Mahanadi Delta, eastern Assam valley, Cauvery delta.

Wheat

- **Climatic Condition-** Cool climate, 30 cm. rainfall during growing period, clayey alluvial is best suitable, raised mainly in area of rainfall annually less than 100cm.
- India is not ideally suited for wheat cultivation due to short & relatively warm and dry winter season. In Punjab best favourable climate exists. It requires 5 to 5 ½ months to ripen but in south the growing period is shorter.

Barley

- Climatic conditions for its growth are the same as for wheat. However, it can well thrive even in more cooler climate so its potential area is much wider. But its yield is not as of wheat so its percentage contribution in total food grain production is not much.
- It is useful for production of malt which again is used for brewing beer and other alcoholic products.

Maize

- **Climatic Condition-** area of 4 ½ months free from frost, temperature during growing period - 21°- 27°C, but should not fall below 13°C, rainfall - 50-100 cm, well drained loamy soil rich in N₂, grown as kharif crop in all the States,
- **Area-** mainly north of a line connecting Surat with Calcutta (excluding Kutch, West Rajasthan and Ladakh), in the North East (Meghalaya, Nagaland, Manipur, Mizoram), northern districts of Andhra and adjoining districts of Maharashtra & Bastar (M.P.).

Jowar/Sorghum

- **Climatic Condition** - Rainfall below 100 cm, needs 30 cm rain during growing season, mean monthly temperature - 20°C-33°C, clayey deep regur and alluvium for better yield.
- **Area** - On Indian Plateau west of 80°E meridian; in Maharashtra Plateau region it is the most important cereal, south of Pune 80% agriculturable land under it; in Andhra, Maharashtra, Karnataka as Rabi and as Kharif elsewhere.

Pulse

- **Kharif crop-** Arhar/Tur, Moong, Urad, Moth, etc. throughout India.
- **Rabi crop-** Gram, Peas, Khesari, Masur, Urad, etc. in North India.
- Pulses occupies 13% of total Indian cropped area while 90% area under it is rainfed.
- Gram, Peas & Arhar together occupies about 50% of area under all pulses.
- Kharif pulses are grown more in T.N., Gujarat, Maharashtra and Punjab.
- Rabi pulses are grown mainly in MP, UP, Haryana and West Bengal.

Oil Seeds

- A. Groundnut :** India is the leading producer (1/3 of total world production) and area-wise first in world.
- **Climatic Conditions-** Highly susceptible to frost so not grown in winter season in north of Tropic of Cancer, well drained sandy loam is more suitable, eastern limit in Deccan Plateau is 100 cm Isohyet.
 - **Area-** raised as “kharif” throughout India but as “Rabi” in T.N., Karnataka, Andhra, Orissa; leading producers are Deccan Plateau & Gujarat state; Kharif crop is 90-95% of total area.
- B. Rapeseed and Mustard**
- Area-wise India ranks 2nd in world.
 - **Climate-** Like wheat and gram they thrive only in cool climate and frost damages it; grown as Rabi crop.
 - UP & Rajasthan are the chief producer and together accounts 60% of the country production.
- C. Sesamum/Til**
- Accounts for 1/3 of world production & areawise first in world.
 - **Climate** - Raised throughout India; as Kharif in North India and as Rabi in South India, average monthly temperature - 21°C.
- D. Linseed**
- India accounts 10% of world production & area wise stands first in world.
 - Grown in winter as Rabi crop north of 16° N.
 - Production areas MP, UP, Maharashtra, Bihar, Rajasthan.
- E. Castor seed**
- India contributes 20% world production & area wise first in world.
 - **Climate-** generally raised as a mixed crop in tropical & sub-tropical climate; rainfall - 50-75cm.; light soil; in India all area under castor-seed is rainfed.
 - Raised as Kharif in North India where winters are cool and as Rabi in South India.
- F. Niger Seed**
- Area-wise first in world; used for making soap.

- **Area-** Orissa, M.P., Bihar, Maharashtra.

G. Sun flower

- Area - wise first in the world; raised as Rabi crop.
- Area - Maharashtra alone contributes 75% of total production.

H. Cotton Seed

- Used in chemical industries and as lubricant.
- Area - Gujarat (25%), Maharashtra (17%), Punjab (15%), Karnataka (9%), Andhra (11%) Haryana (7%), T.N. (8%)

Cotton

- India contributes 10% of world production.
- **Climatic Condition-** A sub-tropical crop; temperature - above 21° C & 200 frost free days; rainfall - 75c.m. during growing season (grown mainly in area of 50-100 c.m. rainfall); soil- regur in rain-fed area & heavy alluvial in irrigated area.
- **Area-** mainly in area west of 80°E (excluding arid West Rajasthan West Punjab & Haryana, Ganganagar (Rajasthan), South - West UP, South East - Rajasthan, black cotton soil of Malwa plateau Bihar, Nagpur plain, Kathiawar & Gujarat plain, Northern-Karnataka & neighbouring Andhra and Maharashtra, Western T.N.
- Almost whole of the cotton is picked by the end of December, before winter frost.
- 16% of total area under cotton is irrigated. More than 90% of cotton land of Punjab, Haryana and U.P. are irrigated. Yield is high in rain-fed areas as well as irrigated areas. Plateau of peninsular India is a rain-fed area so low yield without irrigation.

Jute

- India ranks 1st in both area and production, however, Bangladesh stands 1st in export.
- **Climatic condition-** rainfall between 150-300 cm, humidity over 80% , temperature between 24°C & 35°C during growing period, preferred to land subjected to annual flooding, plenty of water is required for cultivation of this crop and for processing it after the harvesting, it occupies the field for 3½ months.
- **Area-** Sown in March and May in lower Brahmaputra valley, West Bengal Plain, Mahanadi

Delta & NE- Bihar. Mesta is produced in Andhra, Maharashtra, Orissa, Bihar, Karnataka, West Bengal, MP, T.N. and NE States.

Tobacco

- India is the 3rd largest producer with 2nd largest growing area, and stands 5th in Flavoueed Virginia tobacco production.
- **Climatic Conditions -** In tropical and sub- tropical area with rainfall about 60 cm. during growing period, 80% humidity is most suitable, well drained sandy loam rich in potash is most favourable.
- **Area-** Production is concentrated in the Ganga basin of N. Bihar, Godavari & Krishna delta of Andhra, Madurai, Belgaum, Baroda, Satara and Kaira near Mumbai.
- In production Gujarat ranks first followed by A.P., U.P., Karnataka and Bihar.

Sugarcane

- India has the largest area in sugarcane production in the world and also leads in production.
- **Climatic Conditions-** Temperature - 25°C, hot dry wind is inimical, annual rainfall from 75 to 100 cm plus limited irrigation, well drained raddish loamy soil rich in N₂, Ca and Phosphorus are essential for good yield, cool dry climate during the maturing period promotes the sucrose content, occupies the field for 10 to 12 month.
- **Area-** South India has advantage in sugarcane as it reflects the best suited tropical conditions and a longer period of crushing almost twice over the north.
- North India produces the sugarcane in sub-tropical condition. Main area in Ganga plain west of the longitude of Patna and to the north of Yamuna contributing 50% of the total cane production in India.
- Cost of manufacturing sugar in India is high mainly due to low yield and short crushing period as in N-Indian plain. Its cultivation in S. India is confined to those area where irrigation is available. In Andhra, T.N., Karnataka, and Maharashtra 100% of the area under sugarcane is irrigated.
- North India produces 70% of the total production.

Tea

- India accounts about 30% of global output followed by China (21.5%), Sri Lanka (9.5%) and

Kenya (8%). However, Sri Lanka has overtaken India in terms of volume of export but in value term of export India is ahead.

- South India's productivity is highest in the world specially in Nilgiri of T.N.
- **Climatic Conditions-** Hot climate with temperature 21°C-32°C, rainfall more than 150 cm. Most suited soil is deep loamy rich in humus, virgin forest soil with very little calcium but enough of iron are best suited to tea.
- **Area-** NE- India contributes about 80% of the total country production while the south India contributes 20% of India's total output.
 - a) **Assam-** On flat and alluvial lands on either side of Brahmaputra river and in the region south of Assam hills like in Cachar. These tea have poor flavour but good liquor.
 - b) **W.Bengal-** In Darjeeling (3000-4000 ft high) and Jalpaiguri. Darjeeling tea has good flavour and so fetches high price.
 - c) **South India-** Annamalai Hills; Hassan & Chikmangalur districts of Karnataka, Kottayam, Quilon & Trivandrum districts of Kerala. All these production areas are situated at the elevation of 760 to 1520 meter above the sea level.
 - d) Dehradun district of UP & Dharmasala in Kangra districts of Himachal Pradesh also produces some amount of tea.
 - e) **Kolkata and Cochin -** Chief tea exporting port. However the tea export from India faces the problems of over supply in the world market, increased cost of production and increasing competition from Sri Lanka and East African countries. The new comers in the field of export like E. Africa, Argentina and other traditional exporting countries like Taiwan, Japan and Sri Lanka are gradually replacing Indian tea in the world market.

Coffee

- The first plantation in India was started on the Malabar coasts. English planters commenced coffee planting industry with large estates near Chikmangalur in 1826.
- India contributes 4% of total world production of which 70% is reserved for export.
- Arabica & Robusta are the two main varieties of coffee grown in India accounting for 49% and 51% of area under cultivation respectively.

- **Area-** Coffee is largely grown on the eastern sheltered slopes of Western Ghats near 15°N latitude in Kerala, Karnataka and T.N.

Spices

- Since the ancient time, India has been holding an important position in production and export of various types of spices. In India about 60 kinds of spices are grown though the most important species are - Chillies, Cardamom, Black-Pepper, Turmeric, Ginger, Large cardamom, Cumin, Coriander, Fenu-greek, Garlic, Saffron, Celery, etc.
- About 95% of total production is consumed in the domestic market.
- Indian share in trade of spices is of about 27% in volume and 9% in terms of value and earns substantial amount of foreign exchange.
- Indian spices export in value terms - Black pepper >Chilli Turmeric > Coriander> Ginger > Cardamom.

Chillies : A.P, T.N, Maharashtra, Karnataka.

Turmeric : Eastern coast specially Andhra, Orissa, T.N.

Cardamom : India is the largest producer and exporter of cardamom. Idukki district of Kerala has the highest concentration and Kerala is also largest producer.

- Area wise Kerala stands first followed by Karnataka and T.N.
- Production wise Kerala also is on the top followed by Karnataka and T.N.

Black-pepper : India is the second largest producer after Indonesia.

- Kerala is the largest producer followed by Karnataka, T.N. and Andaman.

Ginger : Kerala is the most important producer (70%). Other producing States are H.P., M.P., Maharashtra, Karnataka, Rajasthan & W. Bengal.

Areca nut : Meghalaya stands first in the production followed by Orissa, Arunachal Pradesh, Karnataka, Assam, Maharashtra and T.N.

- India produces 75% of world turmeric and 65% world ginger.

FRUITS

- India holds the first position in fruit production, Brazil holds the second position.

Mango : Largest acreage (42%) and production (40%).

- Some important varieties are Alphonso of Maharashtra, Bangnapalli of Andhra, Dashehari & Langra of UP Malda of W. Bengal.
- Largest hectereage of mango is in UP. Other important producing regions are Bihar (second largest producer) A.P., West Bengal, Orissa, T.N., Coastal Maharashtra.

Banana : India produces 11% of world banana, second and largest producer after Brazil.

- Main producing areas are T.N. (Tiruchi), Maharashtra (Jalgaon), Gujarat, M.P., S. Kerala.

Grape : Known as “Anab-e-Shahi”, its productivity is highest in India (85 tonnes/ha).

- Main producing area are Coorg district of Karnataka; Wynad in Kerala; Nilgiri in T.N.; Khasi, Jaintia and Lushai hills in Meghalaya; Pune, Nasik, Sholapur, Songli Ahmed nagar district of Maharashtra; Himachal Pradesh and Andhra.

Citrus : Maharashtra ranks first covering 20% of total citrus area, Nagpur Mandarins is considered to be best in the world. Other main districts are Amravati, Wardha and Vidarbha.

Apple : Among temperate fruits, it alone accounts for more than 50% of total production. NW Himalayan region covers 95% of total area and 85% of total production.

Sapota : India holds the first position in the production.

- High productivity is achieved in Karnataka followed by Maharashtra.

Glimpse of Indian Horticulture

- India is endowed with a remarkably heterogeneous area characterized by a great diversity of agro climatic zones, allowing for production of a variety of horticultural crops - fruits, vegetables, flowers, spices, plantation crops, root and tuber crops, and medicinal and aromatic crops.
- Globally, second largest producer of fruits and vegetables.
- Largest producer of mango, banana, coconut, cashew, papaya, pomegranate etc.
- Largest producer and exporter of spices.

- Ranks first in productivity of grapes, banana, cassava, peas, papaya, etc.
- Export growth of fresh fruits and vegetables in term of value is 14% and of processed fruits and vegetables is 16.27%.

Livestock Resources

- India has the largest livestock population in the world. It accounts for 57% of the buffalo population of the world and 20% of the cattle population. According to the Livestock Census India has about 210 million cattle (42% bullock, 32% cows and 26% young livestock) and 84 million buffaloes.

A. Cattle

- India has about 20 per cent of the world's cattle population. These animals are the backbone of the country's agriculture and have significant contribution in rural economy. Cow provides nutritious milk, while bullocks as draught animals have important contribution in agricultural operations.
- At the state level, Madhya Pradesh has the largest number of cattle (14%), followed by U.P. (12.5%), Bihar (11%), West Bengal (8.5%), Orissa (6.8%), and Karnataka (6.5%).
- The cattle may be classified in the following two categories:

(i) **Milch Breeds :** Gir (Saurashtra-Gujarat, Rajasthan, M.P. and Maharashtra), Red Sindhi, Sahiwal and Deoni are the best milk producing breeds. The Sahiwal original Montgomery are found in Punjab, Haryana, Delhi. The **Deonibreed** is low yielding but hardy for draught purposes. Indian cows yield about 150 kg/year while buffalo yield 500 kg/year.

(ii) **Draught Breeds:** Nagori (Native Jodhpur), Bachaur (Bhagalpur), Kankatha (U.P.), Malwai, Khairgarh, Killari (Sholapur), Bargur, Panwar (Combatore), and Siri (Darjeeling, Sikkim).

B. Buffaloes

- Buffaloes produce more milk than cows in India. The main breeds of buffalo are the Murrah (Rohtak, Hissar, and Gurgaon), Bhadrawati, Jaffarabadi, Surati, Mehsana, Nagpuri, and the Nili-Ravi.

Cattle and Buffalo Development Programmes

The central cattle breeding farms have been set up at Suratgarh (Rajasthan), Dhamroad (Gujarat), Alamadi

(T.N.), Similigudi (Orissa), Adarshnagar (UP). These farms are developing better breeds of cattle and buffaloes.

Problems of Dairying

1. Adverse climate.
2. Shortage of good fodder.
3. Poor breeds, low yields.
4. Problems of collection and marketing.

C. Sheep

- India is the 6th largest sheep rearing country in the world. Most of the sheep in India are however, of poor quality.
- About 55% of the total population of the country is found in Rajasthan. Among other states, Andhra Pradesh, Tamil Nadu, Karnataka, U.P. Maharashtra, J&K, Bihar and M.P. have a substantial proportion of the sheep population.

D. Goats

- About 100 million, Bihar and Jharkhand lead all other states in goat population, followed by Rajasthan, U.P., M.P., Maharashtra, W. Bengal.
- In peninsular India desi goat is popular. Others are Chamba, Mohair (Kashmir) and Barbari (U.P.).

Agricultural Revolutions

A. White Revolution

- A package programme adopted in India to increase the production of milk is known as White Revolution.
- White revolution in India was started in 1970, when the National Dairy Development Board (NDDB) was established to organize dairy development through co-operative societies.
- Dairy development through co-operative societies was first established in the state of Gujarat.
- The co-operative societies are owned and managed by the rural milk producers. The co-operatives, apart from financial help also provide consultancy.
- These co-operative societies were most successful in the Anand district of Gujarat.

- After 1970 the Anand Model was replicated in other districts and states of the country.
- In 1970, the National Dairy Development Board started the Operation Flood which is considered to be the largest dairy development programme in the world.

Objective

- The main objective of these cooperative societies is the procurement, storage and transport of milk.
- Production of a wide varieties of milk products and their marketing management.
- The societies also provide superior breeds of cattle, health service, artificial insemination and veterinary treatment.

Phase of the White Revolution

- **Phase I (1970-1981)** : During this period, the dairy development programme was set up in ten states to provide milk to the cosmopolitan cities (Mumbai, Kolkata, Delhi, Chennai, etc.) The Dairy co-operative societies were set up in 1300 villages with a membership of 15 lakhs.
- **Phase II (1981-85)** : During this phase the dairy development programme was extended to the states of Karnataka, M.P. and Rajasthan. The Dairy Co-operative Societies were set up in 35,000 villages and the membership exceeded 36 lakhs.
- **Phase III (1985-2000)** : The number of co-operative societies went up by 73000 with a membership of 10 million.

Achievements

- The milk production that was 17 million tones in 1951 rose to 140 million tones in 2013-14.
- Reduction in the import of milk and milk product.
- The per capita milk availability per day at present is 290 gms as against only 100 gms before the White Revolution.
- The small and marginal farmers and the landless workers have been especially benefited.

Problems and Prospects

- Collection of milk from remote areas and small dairy farmer is quite expensive.

- Unhygienic production.
- Inadequate marketing facilities.
- Inferior breeds of cattle.

B. Blue Revolution

- Blue revolution means the adoption of a package programme to increase the production of fish, etc.
- The Blue Revolution in India was started during the 5th Five Year Plan (1970) when the Central Government sponsored the Fish Farmers Development Agencies (FFDA).
- Subsequently, the Brackish Water Fish Farms Development Agencies were set up to develop aquaculture.
- As a result of Blue Revolution the production of fish has gone up from 6 lakh tonnes in 1950 to 10 million tonnes at present.
- The fresh water fish has also gone up five times after the Blue Revolution.
- To enhance the production of fish now bio-fertilizers and processed organic wastes are being applied in ponds, lakes, backwaters, rivers and coastal lakes.

Problems

- Inadequate information about the environment (temperature, etc.) of sea, lakes, water bodies.
- Unpredictable nature of Monsoon.
- Inadequacy of research facilities.
- Problems of marketing, storage and transportation.
- Pollution in water bodies, river, lakes, ponds and coastal seas.

C. Green Revolution:

Elements involved:

- Continuing expansion of farming areas;
- Double-cropping in the existing farmland; and
- Using seeds with improved genetics.

Positive Impacts:

- This established India as one of the world's biggest agricultural producers.
- India became an exporter of various food grains around that time.
- Growth of local manufacturing units to produce more fertilizers, pesticides and other chemicals.
- Construction of dams boosted industrial growth, created jobs and improved the quality of life of the people in villages.
- India paid back loans it had taken from the World Bank and its affiliates. This improved India's creditworthiness in the eyes of the lending agencies.
- Developed countries, especially Canada, asked the Indian government to supply them with farmers, experienced in the methods of the Green Revolution. These people remitted part of their incomes India. This added, albeit modestly, to India's foreign exchange earnings.
- There was creation of massive employment opportunities.

Negative Impacts:

- **Sluggish increase in Productivity:** There are signs of stagnation in the increase of productivity in major foodgrain, despite enhanced application of inputs.
- **Partial Revolution :** GR remained confined to only a few crops, the productivity of coarse grains like Bajra, millets, maize and pulses has declined.
- **High cost of cultivation:** The cost of cultivation including fertilizer consumption, the consumption of pesticides, cost of irrigation has gone up many fold.
- **Regional Disparity:** Green revolution being the activity of pro rich farms confined only to the economically developed states within a region.
- **Environment Deterioration:** The user of fertilizers and pesticides have polluted both surface water and groundwater sources. Erection of dams have created inundation of forests and monuments, increased susceptibility to earthquakes.

List of other agricultural revolutions

Black Revolution	Petroleum production
Golden Fiber Revolution	Jute production
Grey Revolution	Fertilizer production
Pink Revolution	Meat & Poultry
Red Revolution	Tomato production
Round Revolution	Potato production
Silver Fiber Revolution	Cotton production
Silver Revolution	Egg/Poultry production
White Revolution	Milk/Dairy production (In India - Operation Flood)
Yellow Revolution	Oil Seeds production
Evergreen Revolution	Overall development of Agriculture

Problems faced by agricultural sector

a) Poor composition of public expenditures:

- Inadequate productivity-enhancing investments in agricultural research, investments in rural infrastructure, and the health and education of the farmers.

b) Over-regulation of domestic agricultural trade:

- Over-regulation of domestic trade has increased costs, price risks and uncertainty, undermining the sector's competitiveness.

c) Government interventions in labor, land, and credit markets:

- This is constraining the rapid growth of the rural non-farm sector.

d) Weak Framework for Sustainable Water Management and Irrigation:

- Inequitable allocation of water.
- Deteriorating irrigation infrastructure.

e) Inadequate Access to Land and Finance:

- Stringent land regulations discourage rural investments.
- Computerization of land records has brought to light institutional weaknesses.
- Rural poor have little access to credit.

f) Weak Natural Resources Management:

- A purely conservation approach to natural resources management does not work effectively and does little to reduce poverty.

g) Weak delivery of basic services in rural areas

- A highly centralized bureaucracy with low accountability and inefficient use of public funds limit their impact on poverty.

Recent initiatives by the government

1. Mera Gaon, Mera Gaurav

- This scheme is being launched involving agricultural experts of agricultural universities and ICAR institutes for effective and deeper reach of scientific farming to the villages.
- A group of experts will be associated with one particular village to create awareness and adoption of new technologies including farm investment, loans, availability of inputs and marketing.
- All the scientists from ICAR and agricultural universities will participate in this initiative.

2. Krishi Dak

- IARI initiated this novel scheme in 20 districts in which postmen supplied seeds of improved varieties of crops to the farmers in far-flung areas.
- Owing to its success and popularity, this scheme is being extended in 100 districts of 14 states with the association of Krishi Vigyan Kendras.

- This will provide improved seed to farmers at their doorstep.
- 3. Soil Health Card**
- Soil Health Cards are necessary to ensure that only requisite nutrients are applied in the soil in a balanced manner to enhance productivity of specific crops in a sustainable manner.
 - Values on soil parameters such as pH, EC, N, P, K, S, Zn, Fe, Mn, Cu & B.
 - Recommendation on appropriate dosage of fertilizer application based on test values and requirement of crop, use of organic manures and soil amendments to acidic/alkaline/sodic soils.
- 4. Paramparagat Krishi Vikas Yojna (PKVY)**
- Aim of the project is to maximize the utilization of natural resources through eco-friendly cultivation.
 - Organic farming is a method of farming system which primarily aimed at cultivating the land and raising crops in such a way, as to keep the soil alive and in good health by use of organic wastes (crop, animal and farm wastes, aquatic wastes) and other biological materials along with beneficial microbes (bio-fertilizers) to release nutrients to crops for increased sustainable production in an eco friendly pollution free environment.
- 5. Pradhan Mantri Krishi Sinchai Yojana (PMKSY)**
- GOI had announced 'Pradhan Mantri Krishi Sinchayee Yojana' with the motto of water to every farm 'Har Khet Ko Paani'. The scheme is aimed at irrigating the field of every farmer and improving water use efficiency to provide "Per Drop More Crop".
- 6. Promotion of National Market through Agri Tech Infrastructure Fund (ATIF)**
- Central Sector Scheme for Promotion of National Agricultural Market through Agri-Tech Infrastructure Fund (ATIF) for Rs.200 crores to be implemented during 2014-15 to 2016-17.
 - The Scheme envisages initiation of e-marketing platform at the national level and will support creation of infrastructure to enable e-marketing in 642 regulated markets across the country.
 - For creation of a National Market, a common platform across all States is necessary. It is,

therefore, proposed that a Service Provider be engaged centrally who would build, operate and maintain the e-platform on PPP (Build, Own, Operate, Transfer - BOOT) model. This platform would be customized/configured to address the variations in different states.

- As an initiative of deregulation, States have been advised by the Government of India to bring fruits and vegetables out of the ambit of APMC Act. In pursuance of this advisory, 12 States have, so far, either de-regulated the marketing of fruits and vegetables or have exempted from levying of market fee.

7. Agriculture credit to RIDF

- The RIDF was set up by the Government in 1995-96 for financing ongoing rural Infrastructure projects. The Fund is maintained by the National Bank for Agriculture and Rural Development (NABARD). Domestic commercial banks contribute to the Fund to the extent of their shortfall in stipulated priority sector lending to agriculture. The main objective of the Fund is to provide loans to State Governments and State-owned corporations to enable them to complete ongoing rural infrastructure projects.

8. MUDRA Bank

- The Finance Minister has proposed to create a Micro Units Development Refinance Agency (MUDRA) Bank, with a corpus of Rs. 20,000 crore, and credit guarantee corpus of 3,000 crore, which will refinance Micro-Finance Institutions through a Pradhan Mantri Mudra Yojana.
- Priority will be given to SC/ST enterprises in lending. MUDRA Bank will operate through regional level financing institutions who in turn will connect with last mile lenders such as MFIs, Small Banks, Primary Credit Cooperative Societies, Self Help Groups (SHGs), NBFC (other than MFI) and other lending institutions.
- MUDRA Bank will refinance Micro-Finance Institutions through a Pradhan Mantri Mudra Yojana (PMMY). In lending, priority will be given to SC/ST enterprises. These measures will greatly increase the confidence of young, educated or skilled workers who would not be able to aspire to become first generation entrepreneurs; existing small businesses, too will be able to expand their activities. Since the MUDRA Bank will be set up through an enactment of law and it will take some time.

9. Rashtriya Gokul Mission

- India ranks first among the world's milk producing Nations and milk production peaked at 137.97 million tonnes in 2013-14.
- India has the largest bovine population in the world. The bovine genetic resource of India is represented by 37 well recognized indigenous Breeds of cattle and 13 breeds of buffaloes. Indigenous bovines are robust and resilient and are particularly suited to the climate and environment of their respective breeding tracts.
- Rashtriya Gokul Mission, a project under the National Program for Bovine Breeding and Dairy Development is being launched with the objective of conserving and developing indigenous breeds in a focused and scientific manner.
- The potential to enhance the productivity of the indigenous breeds through professional farm management and superior nutrition, as well as gradation of indigenous bovine germplasm will be done with an outlay of Rs.550 crores.

10. Participatory Guarantee System

- Participatory Guarantee System is a process of certifying organic products, which ensures agriculture production process in accordance with the standards laid down for organic products, and that desired quality has been maintained.
- This is exhibited in the form of documented logo or a statement. In order to promote domestic organic market growth and also to enable small and marginal farmers to have easy access to organic certification, a decentralised organic farming certification system called Participatory Guarantee System - India (PGS-India) is implemented by the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India. It is cost-effective, farmer-friendly and hassle-free. It is outside the framework of third party system of certification, which is a pre-requisite to enter export market of organic produce.
- It is a quality assurance initiative that is locally relevant with active participation of stakeholders, including producers/farmers, traders and consumers in certification system. This group certification system is supported by Paramaparagat Krishi Vikas Yojana (PKVY) scheme. It, in a way, supports domestic demand for organic produce and trains farmers in document management and adherence to other requirements of certification process and prepares

them to opt for third party certification if they wishes to go for export.

11. Pradhan Mantri Fasal Bima Yojana

- The main motto of this new crop insurance scheme is to provide a more efficient insurance support to the farmers of the country and become a financial support to thousands of farmers.
- There will be a uniform premium of only 2% to be paid by farmers for all Kharif crops and 1.5% for all Rabi crops. In case of annual commercial and horticultural crops, the premium to be paid by farmers will be only 5%. The premium rates to be paid by farmers are very low and balance premium will be paid by the Government to provide full insured amount to the farmers against crop loss on account of natural calamities.
- There is no upper limit on Government subsidy. Even if balance premium is 90%, it will be borne by the Government.
- Earlier, there was a provision of capping the premium rate which resulted in low claims being paid to farmers. This capping was done to limit Government outgo on the premium subsidy. This capping has now been removed and farmers will get claim against full sum insured without any reduction.
- The use of technology will be encouraged to a great extent. Smart phones will be used to capture and upload data of crop cutting to reduce the delays in claim payment to farmers. Remote sensing will be used to reduce the number of crop cutting experiments.

Impact of Climate change on agriculture

- More extreme temperature and precipitation can prevent crops from growing.
- Extreme events, especially floods and droughts, can harm crops and reduce yields.
- A shift in climate and agricultural zones towards the poles.
- Changes in production patterns due to higher temperature.
- A boost in agricultural productivity due to increased carbon dioxide in the atmosphere.
- Increased vulnerability of the landless and the poor.

- Many weeds, pests and fungi thrive under warmer temperatures, wetter climates, and increased CO₂ levels.

Sustainable agriculture

- Agriculture is sensitive to short-term changes in weather and to seasonal, annual and long term variations in climate.
- Sustainable agriculture aims to produce healthful food without compromising future generations' ability to do the same.

Benefits of sustainable agriculture:

1. Environmental Preservation

- No use of toxic chemical pesticides, synthetic fertilizers, genetically modified seeds.
- Devoid of practices that degrade soil, water, or other natural resources.
- Uses techniques such as crop rotation, conservation tillage, and pasture-based livestock husbandry.
- Sustainable farms protect biodiversity and foster the development and maintenance of healthy ecosystems.

2. Protection of Public Health

- Absence of harmful chemicals in the food products adds a high degree safety angle to the consumers.



- Abstaining from chemicals is a factor to good health of farm workers and the communities.
- Rejecting the use of non therapeutic antibiotics or arsenic-based growth promoters in feed animals and fish farming saves the humanity from the dangerous menace of antibiotics resistance.

- Careful, responsible management of livestock waste; sustainable farmers also protect humans from exposure to pathogens, toxins, and other hazardous pollutants.

3. Sustaining Vibrant Communities

- Has ability to remain economically viable.
- Providing farmers, farm workers, food processors, and others employed in the food system with a livable wage, and safe, fair working conditions.
- Sustainable farms also bolster local and regional economies, creating good jobs and building strong communities.

4. Upholding Animal Welfare

- Sustainable farmers and ranchers treat animals with care and respect.
- Livestock husbandry practices implemented that protect animals' health and wellbeing.
- Livestock being raised on pasture, animals are able to move freely, engage in instinctive behaviors, consume a natural diet, and avoid the stress and illness associated with confinement.