

Forum IAS

Agriculture

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Table of Contents

CHAPTER 1	4
1.1 IMPORTANT MINISTRIES.....	4
1.2 AGRICULTURE SECTOR.....	5
1.3 ALLIED SECTORS: ANIMAL HUSBANDRY, DAIRYING, AND FISHERIES SECTOR.....	5
1.4 FOOD PROCESSING SECTOR	6
1.5 GENERAL ISSUES WITH AGRICULTURE SECTOR	6
CHAPTER 2.....	9
2.1 LABOUR.....	9
2.2 LAND.....	12
2.2.1 LAND REFORMS IN INDIA POST INDEPENDENCE.....	14
2.2.2 BHOODAN and GRAMDAN MOVEMENT	15
2.2.3 LAND USE IN INDIA.....	15
2.2.3 NATIONAL LAND RECORDS MODERNIZATION PROGRAMME (NLRMP-2008).....	16
2.2.4 The SCHEDULED TRIBES AND OTHER TRADITIONAL FOREST DWELLERS (RECOGNITION OF FOREST RIGHTS) ACT, 2006	17
2.2.5 MODEL AGRICULTURE LAND LEASING ACT, 2016	18
2.3 SEEDS	18
2.3.1 NATIONAL SEED POLICY, 2002	19
2.3.2 NATIONAL SEED PLAN	20
2.3.3 DRAFT SEED BILL, 2019	20
2.3.4 PROTECTION OF PLANT VARIETIES AND FARMERS' RIGHTS (PPV&FR) ACT, 2001	20
2.3.5 SEED BANK/SEED VAULT	21
2.3.6 SEED VILLAGE	21
2.3.7 GREEN REVOLUTION AND SEEDS	21
2.4 FERTILIZERS	25
2.4.1 NUTRIENT BASED SUBSIDY (NBS)	27
2.4.2 UREA SUBSIDY.....	27
2.4.3 OTHER INITIATIVES	28
2.4.4 NEEM COATED UREA.....	28
2.4.5 SOIL HEALTH CARD	28
2.4.6 DIRECT BENEFIT TRANSFER (DBT)	29
2.5 PESTICIDES.....	30
2.6 ORGANIC FARMING.....	33
2.7 WATER.....	36
2.7.1 IMPORTANT MINISTRIES AND DEPARTMENTS	36
2.7.2 IRRIGATION	36
2.7.3 PRADHAN MANTRI KRISHI SINCHAYEE YOJANA (PMKSY)	44
2.7.4 PRADHAN MANTRI KISAN URJA SURAKSHA EVAM UTTHAAN MAHAABHIYAN (PM KUSUM)	44
2.7.5 ATAL BHUJAL YOJANA.....	45
2.7.6 MISCELLANEOUS.....	45
2.8 FARM MECHANIZATION.....	49

2.9 AGRI-FINANCE	52
2.10 AGRI-INSURANCE	55
CHAPTER 3.....	59
3.1 CROPS AND CROPPING PATTERNS.....	59
3.1.1 CROPPING PATTERNS.....	59
3.1.2 FARMING SYSTEMS.....	60
3.1.3 CROPS	62
3.2 STUBBLE.....	87
CHAPTER 4.....	89
4.1 AGRICULTURAL SUBSIDIES AND MSP	89
4.1.1 AGRICULTURAL SUBSIDIES	89
4.1.2 AGRICULTURE PRICING POLICIES	92
4.2 PUBLIC DISTRIBUTION SYSTEM, BUFFER STOCKS AND FOOD SECURITY	96
4.2.1 PUBLIC DISTRIBUTION SYSTEM IN INDIA (PDS).....	96
4.2.2 BUFFER STOCKS.....	98
4.2.3 FOOD SECURITY.....	100
4.3 STORAGE AND TRANSPORT OF AGRICULTURAL PRODUCE.....	103
4.3.1 STORAGE OF PRODUCE.....	103
4.4 AGRICULTURAL MARKETING.....	105
4.4.1 AGRICULTURE PRODUCE MARKETING COMMITTEES (APMC).....	105
4.4.2 INTEGRATED SCHEME FOR AGRICULTURAL MARKETING (ISAM).....	106
4.4.3 e-NAM (ELECTRONIC NATIONAL AGRICULTURAL MARKETS)	106
4.4.4 GRAMIN AGRICULTURAL MARKETS (GrAMs)	109
4.4.5 FARM LAWS 2020.....	109
4.4.6 AGRI-EXPORTS.....	112
4.5 INCOME SUPPORT TO FARMERS	113
4.5.1 PM KISAN	113
4.5.2 PM KISAN MAAN DHAN YOJANA	114
4.5.3 RAISING FARM INCOMES	115
4.6 AGRICULTURAL PRICE VOLATILITY	116
4.6.1 FOOD INFLATION	117
4.6.2 FOOD DEFLATION.....	121
CHAPTER 5.....	122
5.1 MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE (MIDH).....	122
5.2 NATIONAL MISSION ON AGRICULTURE EXTENSION AND TECHNOLOGY (NMAET).....	123
5.3 NATIONAL MISSION ON OILSEEDS AND OIL PALM (NMOOP).....	125
5.4 NATIONAL SAFFRON MISSION	125
5.5 TECHNOLOGY MISSION ON OILSEEDS, PULSES AND MAIZE (TMOP)	125
5.6 NATIONAL MISSION ON SUSTAINABLE AGRICULTURE (NMSA).....	126
5.7 NATIONAL FOOD SECURITY MISSION (NFSM)	126
5.8 RASHTRIYA KRISHI VIKAS YOJANA (RKVY)	126

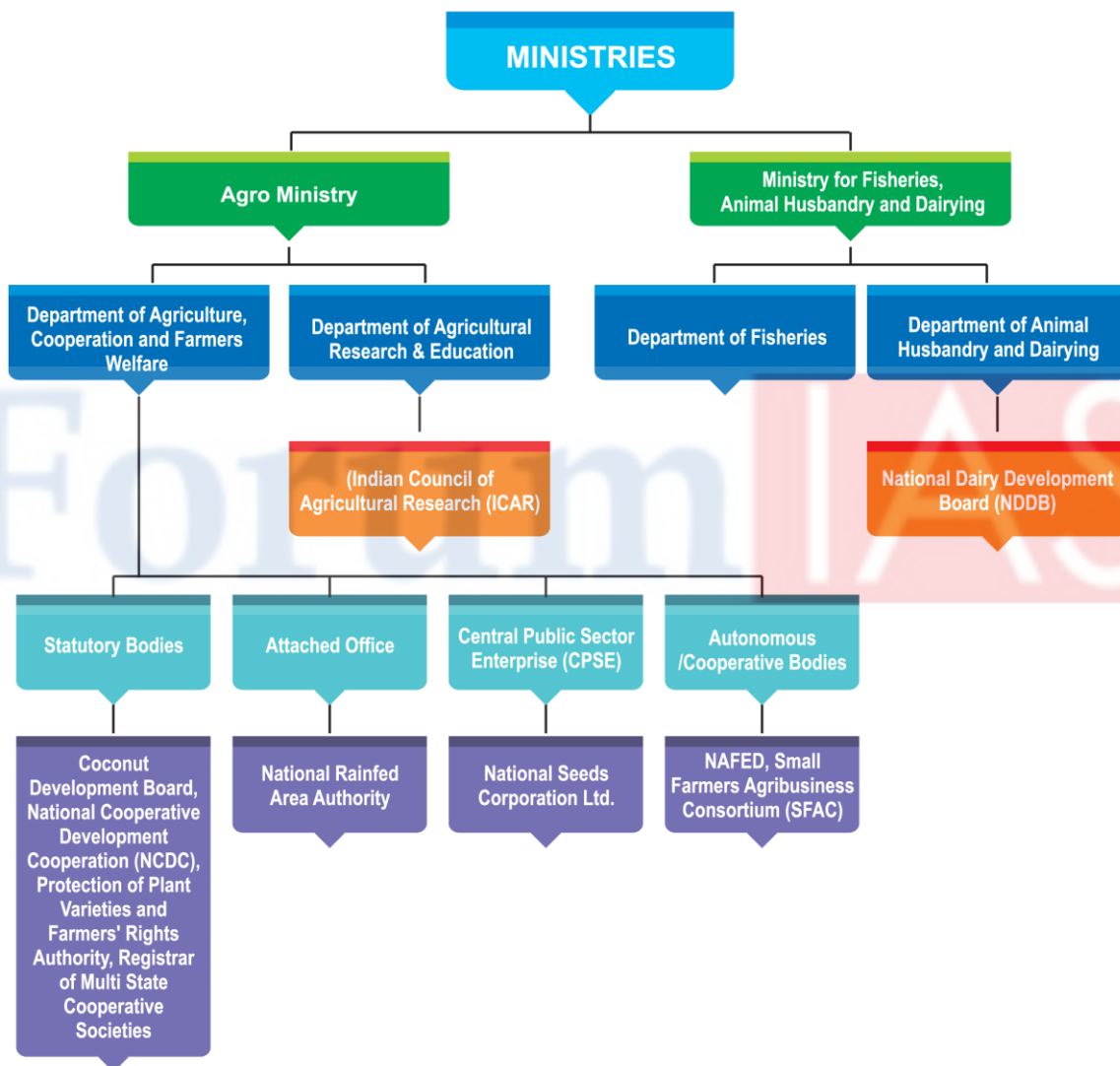
CHAPTER 6.....	128
6.1 NATIONAL e-GOVERNANCE PLAN IN AGRICULTURE (NeGP-A)	128
6.2 DRONE TECHNOLOGY IN AGRICULTURE.....	130
6.3 BIG DATA IN AGRICULTURE	130
6.4 INTERNET OF THINGS (IoT) IN AGRICULTURE	131
6.5 ARTIFICIAL INTELLIGENCE (AI) IN AGRICULTURE	131
6.6 BLOCKCHAIN TECHNOLOGY IN AGRICULTURE.....	132
6.7 ROBOTICS IN AGRICULTURE	132
6.8 SPACE TECHNOLOGY IN AGRICULTURE.....	133
6.9 ADVANTAGES AND CHALLENGES IN THE SPREAD OF E-TECHNOLOGY	134
CHAPTER 7	135
CHAPTER 8.....	145
8.1 AGRICULTURE EDUCATION	145
8.2 GM CROPS.....	146
8.3 NANOTECHNOLOGY IN AGRICULTURE.....	149
8.4 NATIONAL INITIATIVE ON CLIMATE RESILIENT AGRICULTURE (NICRA)	149
8.5 SYSTEM OF RICE INTENSIFICATION (SRI)	150
8.6 SUSTAINABLE SUGARCANE INITIATIVE (SSI).....	150
8.7 NATIONAL INNOVATION ON CLIMATE RESELIENT AGRICULTURE (NICRA).	150
8.8 KRISHI KALYAN ABHIYAAN	150
8.9 KRISHI VIGYAN KENDRAS (KVKs).....	150
CHAPTER 9.....	152
9.1 ANIMAL HUSBANDRY	152
9.2 DAIRY	156
9.3 FISHERIES SECTOR	159
9.4 MISCALLANEOUS.....	161
CHAPTER 10	162

CHAPTER 1

OVERVIEW

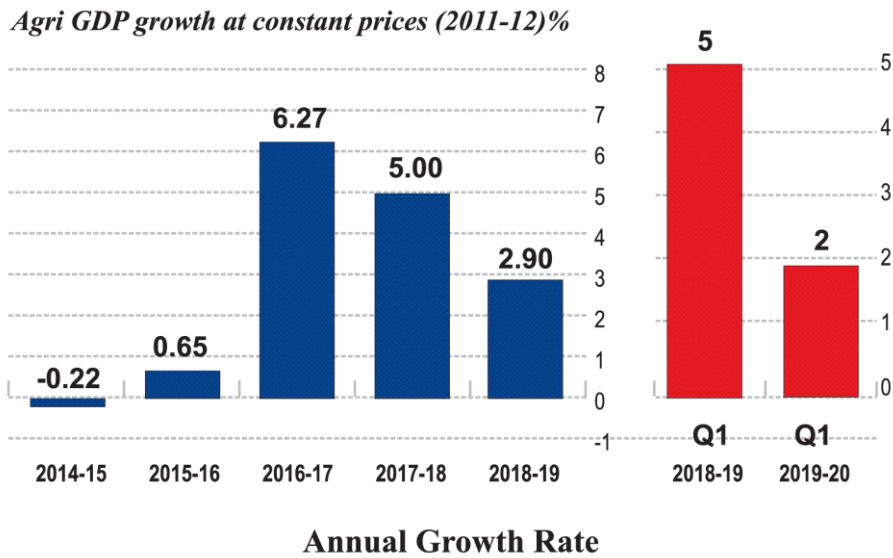
“Few scientists think of agriculture as the chief, or the model science. Many indeed do not consider a science at all. Yet it was the first science- the mother of all sciences; it remains the science which makes human life possible; and it may be that, before the century is over, the success or failure of science as a whole will be judged by the success or failure of agriculture”- T.W. Schultz.

1.1 IMPORTANT MINISTRIES



IMPORTANT MINISTRIES

1.2 AGRICULTURE SECTOR



1. The share of agriculture and allied sectors in the **Gross Value Added (GVA)** of the country has declined from 18.2% in 2015-16 to 17.8% in 2019-20.
 - a. Within the agriculture sector, crops have the highest share in agricultural GDP, followed by livestock, forest, and fishing.
 - b. However, the share of crops has fallen from 11.2% in 2014-15 to 9.4% in 2018-19, but the share of the livestock and fisheries sector increased.
2. As per Census 2011, about **54.6% of the total workforce** of the country is still engaged in agriculture and allied sector activities.
3. **Gross Capital Formation (GCF)** in the agriculture and allied sector as a proportion of GVA has been showing a fluctuating trend from 17.7% in 2013-14 to 16.4% in 2018-19, with a dip to 14.7% in 2015-16.
4. In 2019-20, the **food grain production in India** is estimated at a record high 296.65 million tonnes.
5. India is a **net exporter of agri-products**, and major export destinations include the USA, Saudi Arabia, Iran, Nepal, and Bangladesh.
 - a. Major agricultural exports from India include marine products, basmati rice, buffalo meat, spices, non-basmati rice, raw cotton, oil meals, sugar, castor oil, and tea.
 - b. India's total agri-export basket accounts for a little over 2.5% of world agri-trade.
6. The **agricultural credit flow** target for 2020-21 was fixed at Rs. 15,00,000 crores. However, in this total disbursement, the share of the southern region in agricultural credit was more than 40% while it was less than 2% for North-Eastern Region (NER).

1.3 ALLIED SECTORS: ANIMAL HUSBANDRY, DAIRYING, AND FISHERIES SECTOR

1. **Livestock sector** contributed 4.2% of total GVA in 2018-19. The contribution of livestock in total agriculture and allied sector GVA (at constant prices) has increased from 24.32% (2014-15) to 28.63% (2018-19).
 - a. India is the largest producer of milk with a production of 198.4 million tonnes in 2018-19.
 - b. India ranks 3rd in egg production and 5th in meat production in the world.

2. India is the **second-largest fish-producing country** in the world and accounts for 7.58% of the global production.
 - a. The fisheries sector contributes 1.24% to the GVA and 7.28% to the agricultural GVA.

1.4 FOOD PROCESSING SECTOR

Food processing refers to a variety of industrial operations by which raw foodstuffs are made suitable for consumption, cooking, and storage. During the last 6 years ending 2018-19, food processing industries (FPIs) have been growing at an **average annual growth rate of around 5.06%**. The sector constitutes as much as 8.98% of GVA in manufacturing in 2018-19 at 2011-12 prices.

1.5 GENERAL ISSUES WITH AGRICULTURE SECTOR

Agriculture sector in India faces a multitude of challenges like:

1. **Small and fragmented land holdings:** As per the Agriculture Census 2015-16, the size of average landholding is a mere 1.08 hectares.
2. **Disguised unemployment:** Dependency on agriculture is on the rise due to lack of alternative employment opportunities and burgeoning population resulting in disguised unemployment.
3. **Seeds:** Good quality seeds are out of reach of the majority of farmers, especially small and marginal farmers mainly because of exorbitant prices of better seeds.
4. **Manures, fertilizers, and pesticides:** Excessive use of fertilizers has led to depletion and exhaustion of soils resulting in their low productivity.
5. **Irrigation:** Irrigated area accounts for nearly 48.8% of the 140 million hectares (mha) of agricultural land in India. The remaining 51.2% is rainfed. As a result, much of our agriculture is dependent on monsoon, which is often uncertain, unreliable, and erratic.
6. **Mechanization:** Little or no use of machines is made in ploughing, sowing, irrigation, thinning and pruning, weeding, harvesting, threshing, and transporting the crops. It results in huge wastage of human labor and low yields per capita labor force.
7. **Soil erosion:** Large tracts of fertile land suffer from soil erosion by wind and water, leading to infertility.
8. **Agriculture marketing:** In the absence of sound marketing facilities, farmers have to depend upon local traders and middlemen for the disposal of their farm produce which is sold at a throw-away price. It is these middlemen and local traders who dominate the marketing and trading of agricultural produce. They buy the produce at a lower price from the distressed farmers and sell it at a higher price to the consumers, thus reaping the majority of the profits and the producer does not derive similar benefit.

The **Rural Credit Survey Report** remarked that the producers, in general, sell their produce at an unfavorable place and at an unfavorable time and usually they get unfavorable terms.

9. **Debt trap:** In the absence of bank credit, farmers, especially small and marginal ones, are forced to take loans from local moneylenders who often charge very high interest rates from them. This pushes the farmers into a debt trap as they are unable to repay the costly loans.
10. **Inadequate storage facilities:** In the absence of adequate storage facilities, farmers are compelled to sell their produce immediately after the harvest at the prevailing market prices which are bound to be low. Such distress sale deprives the farmers of their legitimate income. Absence of storage facilities also leads to post-harvest losses.
11. **Inadequate transport:** One of the main handicaps with Indian agriculture is the lack of cheap and efficient means of transportation. Even at present, there are lakhs of villages which are not well connected with main roads or with market centers. Under these circumstances, the

farmers cannot carry their produce to the main market and are forced to sell it in the local market at a low price.

12. **Global scenario:** Global slump in agricultural prices has led to non remunerative pricing for farmers.
13. **Agricultural risks:** Agriculture sector is troubled with several risks like:

Types of risks	Causes	Reasons for severity	Suggested solutions
Production risks	Pests, diseases, shortage of inputs like seeds/irrigation	Low productivity, declining yield	Pest and disease resistant seeds, free markets for inputs, set and enforce standards for quality seeds
Weather and Disaster related risks	High share of rainfed agriculture, low irrigation coverage, drought, flooding, hailstorm, and unseasonal rains	Production loss, lower than production potential	Increase share of irrigated agriculture, restore and expand irrigation, adopt outcome measure of performance such as level of water table, water management
Price risks	Lower than remunerative price	Absence of marketing infrastructure, presence of excessive profiteering by middlemen	Build marketing infrastructure along the value chain, regime based on selective timely interventions
Credit risks	Predominance of informal sources of credit like money lenders, lack of capital for short term and long-term loans	Absence of stable incomes/profits lead to defaults/indebtedness	Increase availability of formal credit and institutional credit to farmers
Market risks	Changes in demand/supply, both domestic and international	Loses market/market share	Allow long term contracts for purchase on pre-determined prices, start direct purchase from farmers by exempting government purchases by PSU, defence, paramilitary, etc.
Policy risks	Uncertain policies, regulations	Impact of government policies, APMC Act, and other regulations	Trade or policy changes to be announced well before sowing and to stay till arrivals and procurement is over

Agriculture Census

Recognizing the importance and predominance of the agriculture sector, the Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India conducts Agriculture Census, quinquennially, since 1970-71. The current Agriculture Census with reference year 2015-16 is tenth in the series. Through Agriculture Census, the data on various structural aspects of operational holdings are collected which are needed by planners, policymakers, researchers, etc.

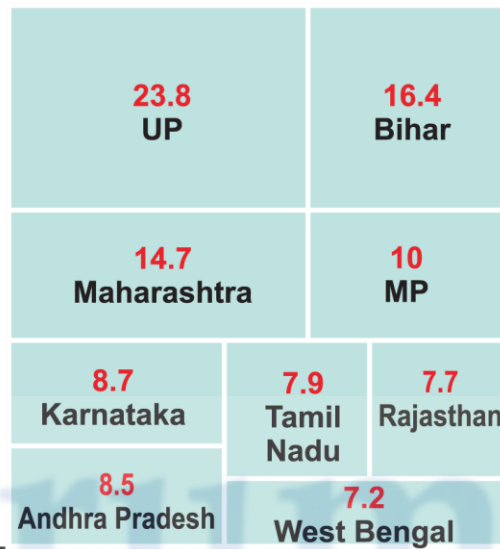
UP BIHAR LEAD IN LAND HOLDINGS

Latest Agriculture Census (2015-16)

No. of operational land holdings
146 million

(Operational land is used wholly or partly for agricultural production)

Top nine states (in million)



Group-Wise % of No. of Holdings

Marginal	Below 1 hectare
Small	1<2 hectare
Semi-Medium	2<4 hectare
Medium	4<10 hectare
Large	10 hectare and above

■ 2015-16 ■ 2010-11; In %

Marginal & Small



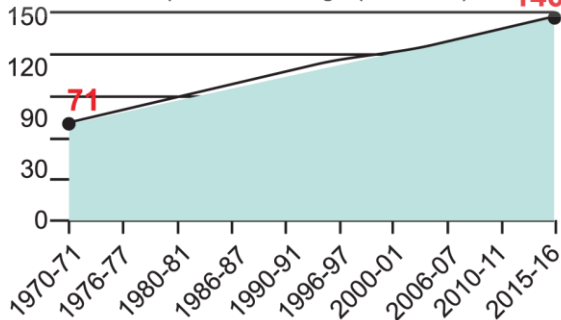
Semi-Medium & Medium



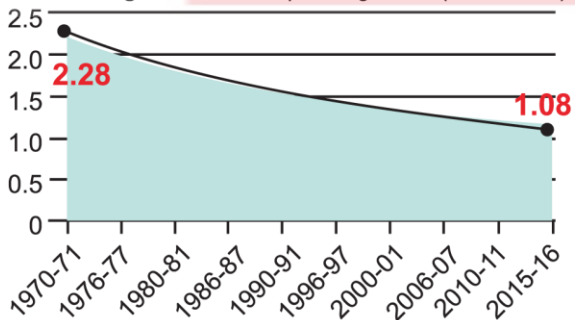
Large



No. of land holdings increasing
Census Year | No. of holdings (in million)



Average size of operational land holding decreasing: Census Year | Average Size (in hectares)



Agriculture Census

Source- Times of India

CHAPTER 2

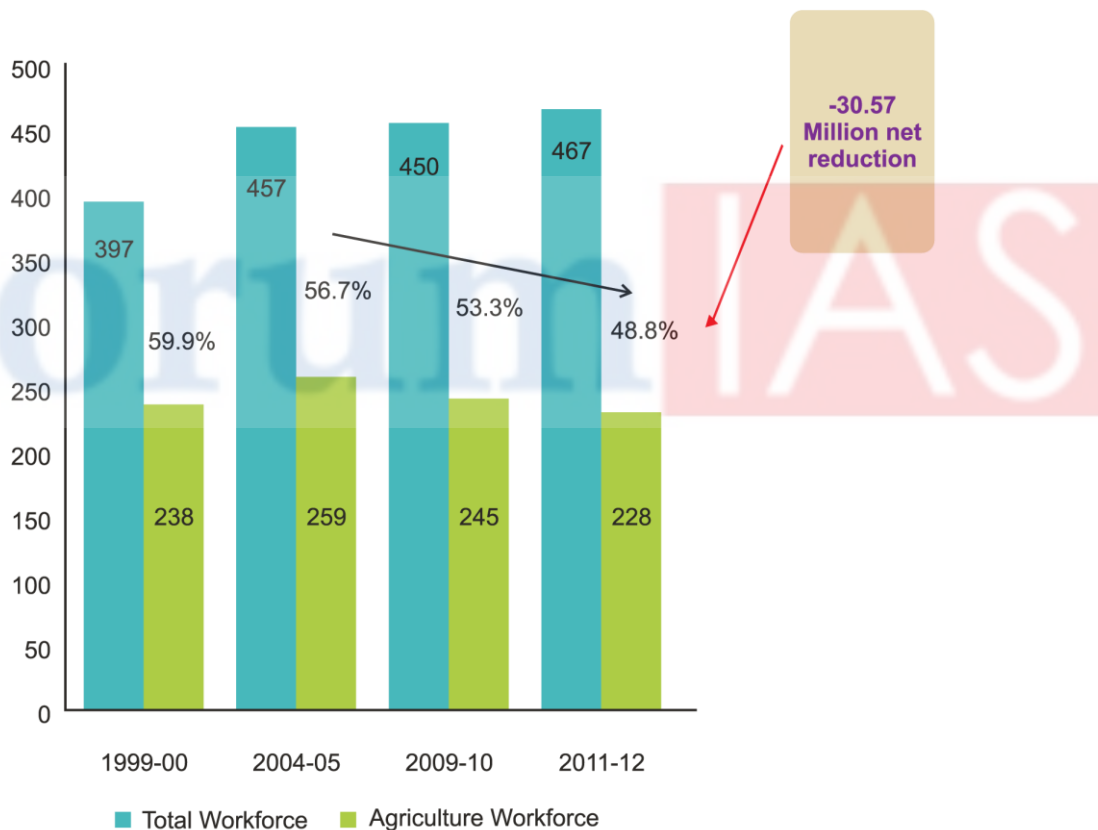
AGRICULTURAL INPUTS

Agricultural inputs refer to the resources that are used in farm production, such as chemicals, equipment, feed, seed, and energy.

2.1 LABOUR

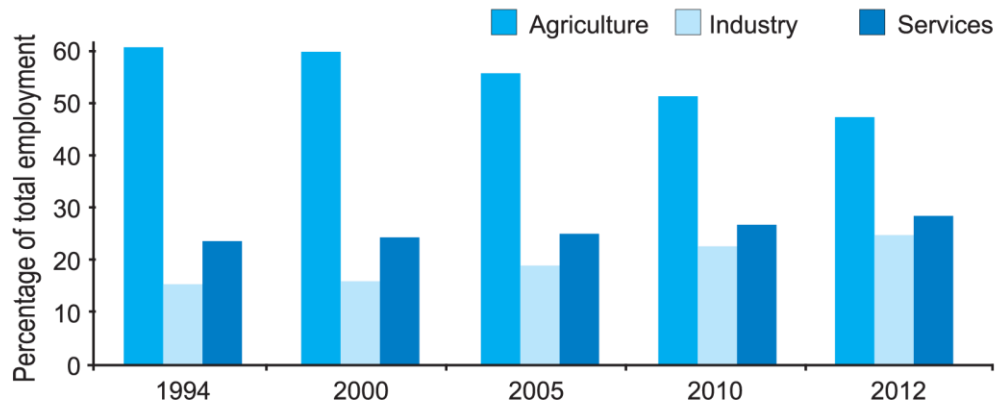
As per the Agriculture Labour Enquiry Committee, agricultural laborers are those who derive their major income by working on the farms of others for a wage. An agricultural laborer has no right of lease or contract and has no risk in the cultivation of land. He merely works on another person's land for a wage.

The agricultural laborers are: (i) engaged in agricultural or allied activities, (ii) work for a wage in cash or kind, (iii) work full time or part-time, whole year or part of a year.



Employment in Agriculture

Source - FICCI

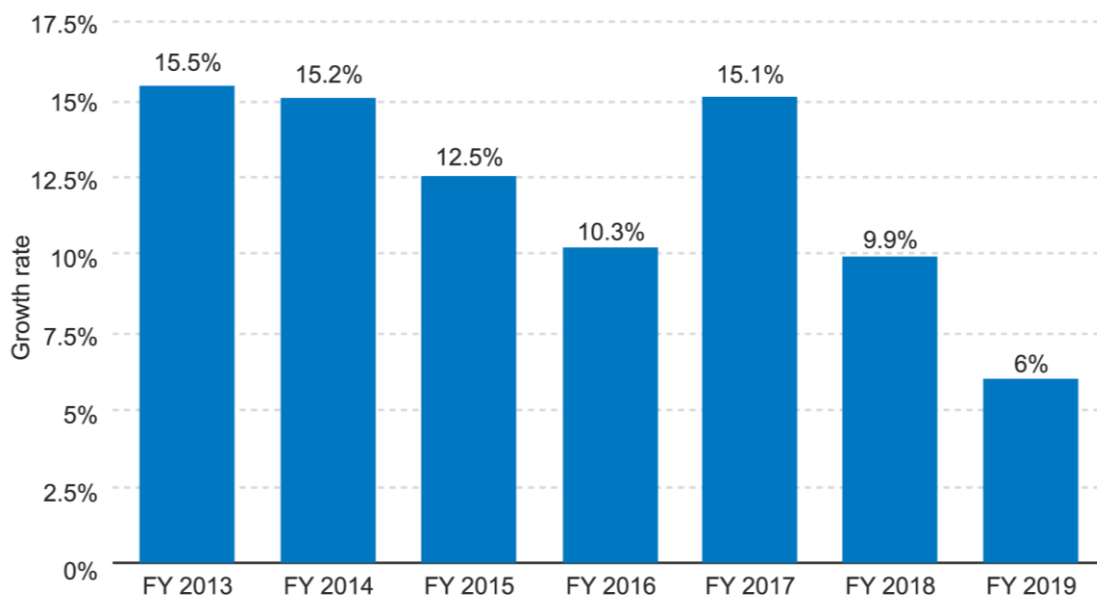


Sectoral composition of employment in India

Source- World Bank

Problems faced by agricultural labor in India are:

1. **Marginalization of agricultural workers:** While the share of agriculture and allied activities in our country's GDP at factor cost has been constantly decreasing from 55.3% in 1950-51 to 14.0% in 2011-12 (at 2004-05 prices), the workforce in agriculture has increased from 97.2 million in 1951 to around 228 million in 2011-12. This in turn has led to the problem of disguised unemployment as the number of workers engaged in agriculture is far more than what is required.
2. **Labor productivity:** The number of workers engaged in agriculture is far more than what is required because industrial growth has been insignificant compared to the population growth and has been unable to absorb the surplus labor. This has led to the problem of **disguised unemployment** and labor productivity has declined. In India, the labor productivity growth rate for the agriculture and allied sector in the fiscal year 2019 was found to be 6% which was the least productive year compared to the last six fiscal years.



Labor productivity growth of the agriculture and allied sector in India (2013 to 2019)

Source- Statista Research Department

3. **Wages and Income:** Agricultural wages and family incomes are very low in India.
4. **Employment and Working Conditions:** Agricultural workers have to face problems like unemployment and underemployment. Due to the seasonal nature of agriculture, for a major part of the year, agricultural workers have to remain unemployed as there is no work on the farms and alternative sources of employment are not present.
5. **Indebtedness:** Due to the paucity of institutional loans in the rural areas, farmers have to rely on the local moneylenders who often lend money at exorbitant interest rates. This pushes farmers into the vicious cycle of debt. Indebtedness has become a major reason for the recent rise in farmer suicides.
6. **Low wages for women workers employed in agriculture:** Female workers are generally forced to work harder in the fields and are paid less than their male counterparts.

Feminization of agriculture

Feminization of agriculture refers to the increasing number of female workers in the agriculture sector. **Economic survey 2017-18** says that with growing rural to urban migration by men, there is 'feminization' of the agriculture sector, with an increasing number of women in multiple roles as cultivators, entrepreneurs and laborers.

As per the Food and Agricultural Organization (FAO), women's contribution to Indian agriculture is about 32%. According to Census 2011, out of the total female main workers, 55% were agricultural laborers and 24% were cultivators.

There are several **positive impacts of feminization of agriculture** like:

1. As per FAO, if women had the same access to productive resources as men, they could increase yields on their farms by 20-30%.
2. Research worldwide suggests that women with access to secure land, formal credit, and access to market have a greater propensity in making investments in improving harvest, increasing productivity, and improving household food security and nutrition.
3. Women can propel the country towards second Green Revolution, and they can change the landscape of development if they get opportunities and facilities.
4. As per Oxfam India, women are responsible for 60-80% of food and 90% of dairy production, respectively.

Challenges faced by women in agriculture:

1. As per Census 2011, only 12.8% of the operational landholdings were owned by women, which reflects gender disparity in ownership of landholdings in agriculture.
2. Lack of ownership of land does not allow women farmers to approach banks for institutional loans as banks usually consider land as collateral.
3. Work by women farmers, in crop cultivation, livestock management or at home, often goes unnoticed.

4. Female farmers are generally excluded from **modern contract-farming arrangements** because they lack secure control over land, family labor, and other resources to guarantee delivery of a reliable flow of produce.
5. With the ongoing innovation in agriculture and the introduction of new technology to automate specific manual labor, women may lose their jobs because they are often responsible for the manual duties.
6. Women farmers in India often face gender discrimination.
7. Lack of skills and insufficient training of women farmers hampers their productivity.
8. Women farmers are poorly represented in the society as well as farmer organizations.
9. When compared to men, women generally have less access to resources and modern inputs (seeds, fertilizers) to make farming more productive.

To encourage more participation of women in agriculture, **the following steps can be undertaken:**

1. Provision of credit without collateral under the micro-finance initiative of NABARD can be undertaken for women farmers.
2. Women self-help groups (SHGs) can be involved to impart training to women farmers in agriculture-related activities.
3. Gender-friendly tools and machines for various farm operations needs to be deployed for women farmers. Farm machinery banks and custom hiring centers can be roped in to provide subsidized rental services to women farmers.
4. Government flagship schemes such as National Food Security Mission (NFSM), Sub-mission on Seed and Planting Material and Rashtriya Krishi Vikas Yojana must include women-centric strategies and dedicated expenditure.

Government measures to encourage women's role in agriculture:

1. The government is earmarking at least 30% of the budget allocation for women beneficiaries in all ongoing schemes and development activities.
2. The government is also giving preference to women under various policies such as organic farming, self-employment scheme, Pradhan Mantri Kaushal Vikas Yojana, etc.
3. 15th October of every year has been declared as Women Farmer's Day.
4. Provisions of issuing Kisan Credit Card to women have been made.
5. The focus is on connecting women self-help groups (SHGs) to micro-credit through capacity-building activities and to provide information and ensuring their representation in different decision-making bodies.

7. **Menace of child labor:** The incidence of child labor is very high in the agriculture sector as not only are they easily available but can also be employed at low wages.

2.2 LAND

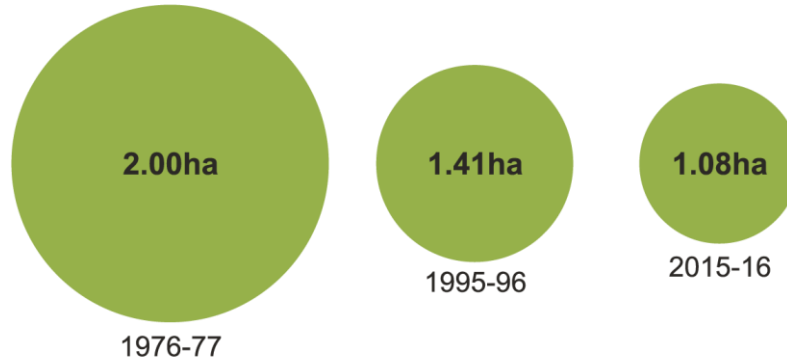
Agriculture is pure land-based activity. The quality and size of land have a direct bearing on the productivity of agriculture. Aside from its value as a productive factor, land ownership also has a social value and serves as a security for credit, natural hazards, or life contingencies, and also adds to the social status. Thus, lack of access to land is directly correlated with the incidence of poverty in rural areas.

The land challenge underlying India's farm crisis

With the rising population, the land is often divided amongst multiple heirs. This leads to the fragmentation of land. As per the Agriculture Census, the average farm size has more than halved from 2.28 hectares (ha) in 1970-71 to 1.08 hectares (ha) in 2015-16.

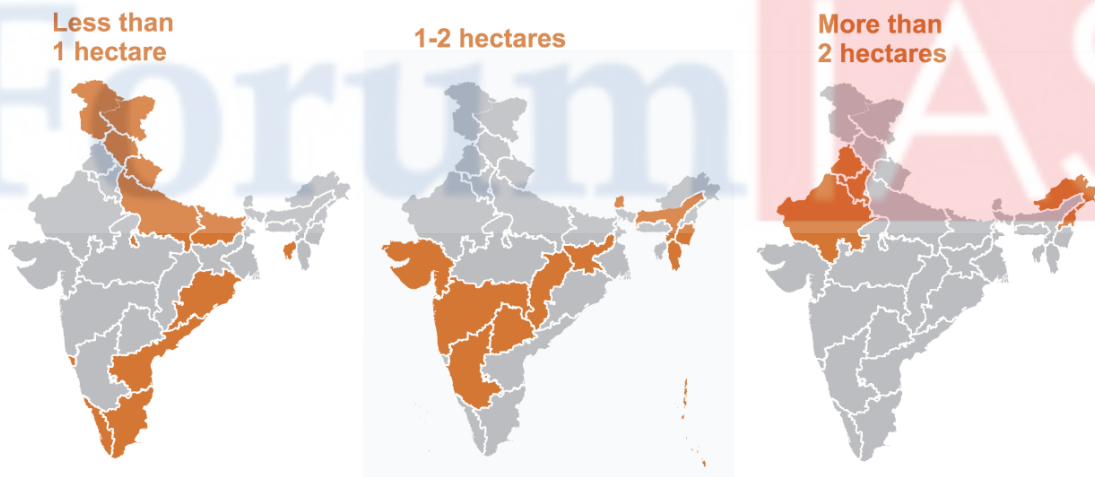
India's shrinking farms

Average farm size (in hectares)



Source: Agriculture Census, Census of India, India Gandhi Institute of Development Research

In 12 Indian states, the average farm size is less than a hectare



Source: Agriculture Census, Census of India, Indira Gandhi Institute of Development Research

Small farms struggle to generate enough income for everyone in a household and often lack alternative sources of income. Also, small sized-farms are not conducive for farm machinery. As a result, the productivity of small farms decline.

Solution to the land challenge

1. Consolidating land into larger farms by enabling land leasing.
2. Computerizing and digitizing land records is needed as without accurate land records, farmers cannot access credit or secure insurance.
3. Providing local rural non-farm employment opportunities to reduce dependency on agriculture.

2.2.1 LAND REFORMS IN INDIA POST INDEPENDENCE

The traditional nature of Indian agriculture was altered by the colonial impact. It created more classes and commoditized land. Colonial rule introduced a high tax regime, the evil of intermediaries like zamindars and sub-zamindars, growth of landlordism, rack-renting on a very wide scale, increased the number of the landless, and so on. Instead of imbibing a modern capitalist outlook, colonial rule pushed agriculture into backwardness. The problem of small holdings was further accentuated by their fragmentations. Extremely high taxes led to high indebtedness and bonded labor.

Further, very little agricultural investment and improvement actually took place. The backwardness of the industry also led to overcrowding of the agriculture and industry failed to absorb surplus labor. To counter agricultural distress, the government initiated a slew of land reforms post-independence.

Land reforms that were started covered four broad areas:

1. **Abolition of intermediaries like zamindars and jagirdars** were undertaken. This led to the end of a parasite class. More lands have been brought to government possession for distribution to landless farmers. The abolition of intermediaries made almost 2 crore tenants the owners of the land they cultivated.
 - a. **Issues:** In many states, intermediaries were allowed to retain possession of lands under their personal cultivation without the limit being set. Besides, in some states, the law applied only to tenant interests like sairati mahals, etc., and not to agricultural holdings. Therefore, many large intermediaries continued to exist even after the formal abolition of zamindari.
2. **Tenancy reforms were undertaken** with the following objectives to (i) guarantee the security of tenure to the tenants who had cultivated a piece of land for a fixed particular number of years, (ii) provide an opportunity for the tenant to gain ownership of the lands he cultivated subject to certain restrictions, and (iii) seek reduction of rents paid by the tenants to a fair level.
 - a. **Issues:** In many states, tenancy reform laws were never implemented very effectively. Despite repeated emphasis in the plan documents, some states could not pass legislation to confer rights of ownership to tenants. Although the reforms reduced the areas under tenancy, they led only to a small percentage of tenants acquiring ownership rights.
3. **Ceilings were placed on landholding**, i.e. the maximum size of landholding that an individual can own was fixed. This was done to deter the concentration of land in the hands of a few.
 - a. **Issues:** In most of the states, these acts proved to be toothless. There were many loopholes and other strategies through which most landowners were able to escape from having their surplus land taken over by the state. In most cases, landowners managed to divide the land among relatives and others, including servants, in so-called 'benami transfers'- which allowed them to keep control over the land.
4. **Cooperativization and Community Development Programs** were started. Cooperative farming means pooling of land and practicing joint agriculture. Each farmer remains the owner of his land individually, but farming is done jointly. Also, profit is distributed among member-farmers in proportion of the land owned by them.

- a. **Issues:** Most of the cooperative societies fell into the hands of rural elites and were victims of politicization. Also, bogus cooperative societies were started to take substantial financial assistance offered by the state in the form of subsidies, agricultural seeds, fertilizers, etc. Pilot cooperative farms were run like any government-sponsored projects rather than being genuinely motivated. Cooperative societies also suffered from huge defaults.

However, it is to be noted that milk cooperative movement which started in Gujarat was highly successful. Peasants of Kheda used to supply milk through intermediary traders into villages and felt cheated and they formed cooperatives to counter this problem and themselves started to supply milk.

Another big achievement of the milk cooperative movement was that around 60% of the beneficiaries were marginal or small farmers. It also promoted indigenous equipment industry as well. Women empowerment also got a significant push by the establishment of many women dairy cooperatives with the help of NGOs like SEWA.

2.2.2 BHOODAN and GRAMDAN MOVEMENT

Bhoodan aimed at land re-distribution in a voluntary manner. **Acharya Vinoba Bhave** who was a Gandhian social worker launched the Bhoodan movement in 1951. He organized 'Sarvodaya Samaj', a federation of constructive workers. He and his followers took a march of feet (padyatra) to persuade large landowners to donate at least 1/6th of their land for redistribution among the landless. He was also joined by **Jayaprakash Narayan** who left active politics for constructive social work.

The movement started from **Pochapalli village of Telangana region**. In the early phases, it received almost 4 million acres as donation. The movement took a new shape in the form of **Gramdan movement** in 1955 which derived its idea from Gandhian notion that all village land belongs to Gopal or God. It meant that all land in a Gramdan village will collectively belong to all villagers.

Successes of the movement:

1. The movement was the first post-independence movement that sought to bring social transformation through a movement and not through government legislation.
2. It created a moral ambience that put pressure on the big landlords.
3. It also stimulated political activity among the peasants and landless, providing a fertile ground for political propaganda to organize peasants.

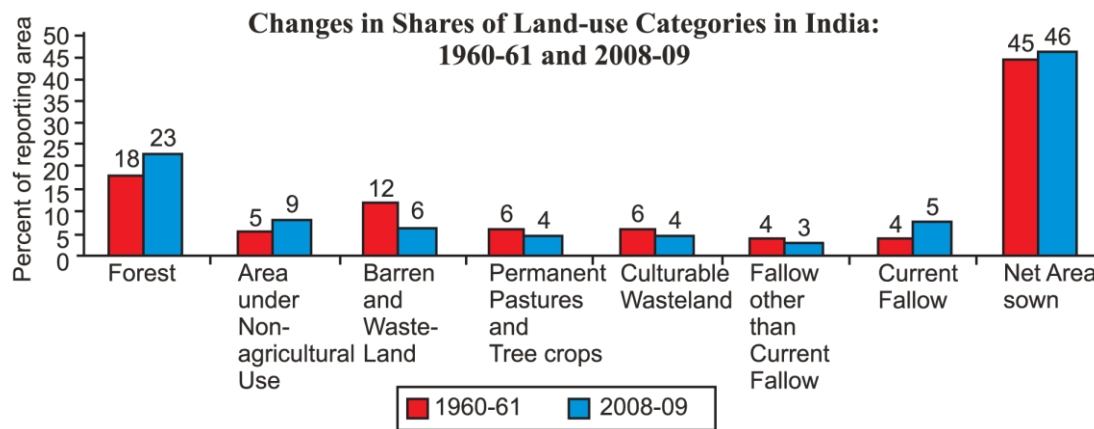
Drawbacks of the movement:

1. The movement lost momentum after some time and failed to realize its revolutionary potential.
2. Most of the land donated was either disputed or unfit for cultivation.
3. Gramdan movement was started in villages where class differentiation had not emerged and there was little difference in ownership of landholdings, mainly in tribal areas. But it was not successful in areas where there was a disparity in landholdings.

2.2.3 LAND USE IN INDIA

Land revenue records mention different land-use categories- forests, land put to non-agricultural uses, barren and wastelands, area under permanent pastures and grazing lands, area under miscellaneous

tree crops and groves (not included in net sown area), culturable wasteland, current fallow, fallow other than current fallow and net sown area.



From the above table, it can be observed that the rate of increase is highest in case of area under non-agricultural uses. The areas under non-agricultural uses is increasing at the expense of wasteland and agricultural land. Also, the increase in net sown area is due to the use of culturable waste land for agricultural purposes.

Agriculture is a purely land based activity. In other words, contribution of land in agricultural output is more compared to its contribution in the outputs in the other sectors. Quality of land has a direct bearing on the productivity of agriculture, which is not true for other activities.

From the mentioned categories of land-use, an estimation of the total stock of agricultural land resources (i.e. total cultivable land) can be arrived at by adding up net sown area, all fallow lands and culturable wasteland.

Table 5.1 : Composition of Total Cultivable Land

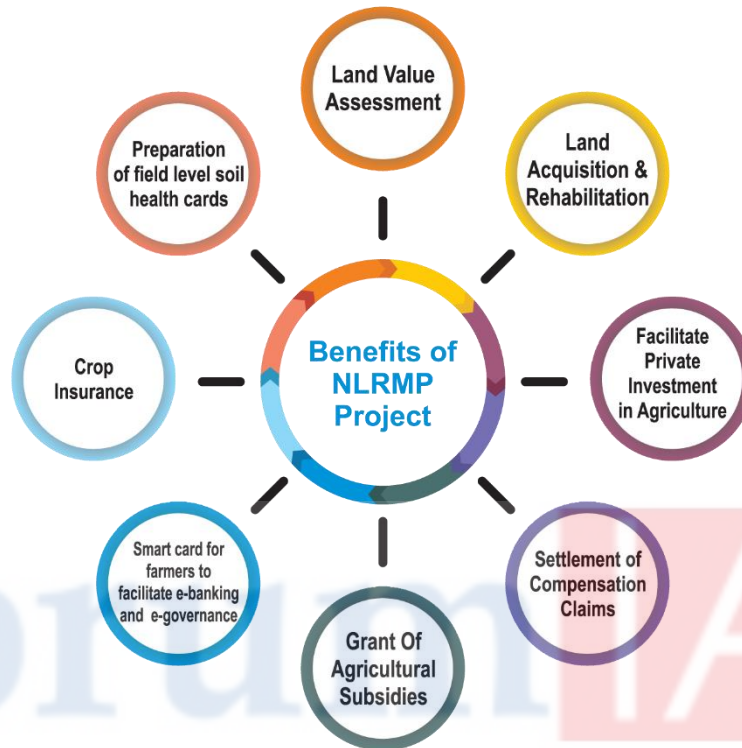
Agricultural Land-use Categories	As a percentage of Reporting Area		As a percentage of total cultivable land	
	1950-51	2014-15	1950-51	2014-15
Culturable Waste land	8.0	4.0	13.4	6.8
Fallow other than Current Fallow	6.1	3.6	10.2	6.2
Current Fallow	3.7	4.9	6.2	8.4
Net Area Sown	41.7	45.5	70.0	78.4
Total Cultivable Land	59.5	58.0	100.00	100.00

2.2.3 NATIONAL LAND RECORDS MODERNIZATION PROGRAMME (NLRMP-2008)

The National Land Records Modernization Programme (NLRMP), launched by the Department of Land Resources under Rural Development Ministry in August 2008, aimed to modernize management of land records, minimize scope of land/property disputes, keep track of land ceilings, enhance transparency in the land records maintenance system and facilitate moving eventually towards guaranteed conclusive titles to immovable properties in the country.

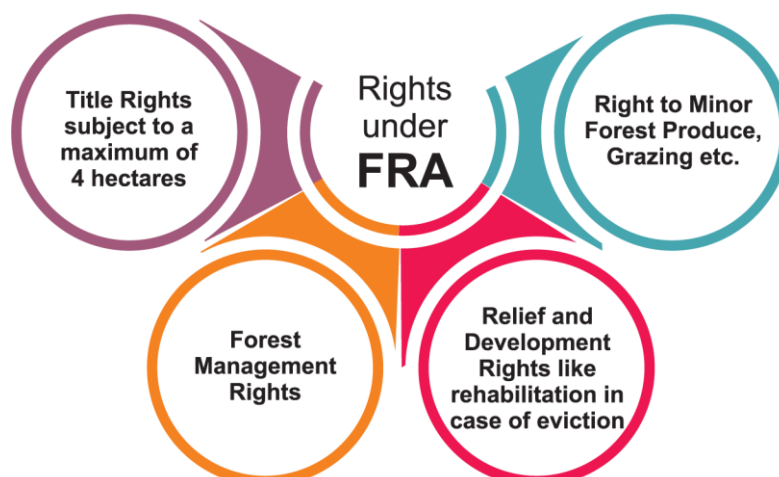
Major Components of the NLRMP Programme includes:

1. Computerization of all land records.
2. Digitization of maps and integration of textual and spatial data.
3. Survey/re-survey and updation of all survey and settlement records including creation of original cadastral records wherever necessary.
4. Computerization of registration and its integration with the land records maintenance system.
5. Development of core Geospatial Information System (GIS) and capacity building.



2.2.4 The SCHEDULED TRIBES AND OTHER TRADITIONAL FOREST DWELLERS (RECOGNITION OF FOREST RIGHTS) ACT, 2006

Forest Rights Act (FRA) deals with the rights of forest dwelling communities over land and other resources. The Act grants legal recognition to the rights of traditional forest dwelling communities, partially correcting the injustice caused by the forest laws. Nodal agency for the implementation of the Act is Ministry of Tribal Affairs (MoTA).



Eligibility to get rights under the Act is confined to those who 'primarily reside in forests' and who depend on forests and forest land for a livelihood. Further, the claimant must be a member of scheduled tribes in that area or must have been residing in the forest for 75 years prior to 13 December, 2005.

Gram Sabha or the village assembly is the initial authority which passes a resolution recommending whose rights to which resources should be recognized.

2.2.5 MODEL AGRICULTURE LAND LEASING ACT, 2016

NITI Aayog came up with the act having the following main features:

1. Legalize land leasing to promote agricultural efficiency, equity and power reduction. This will also help in the much needed productivity improvement in agriculture as well as occupational mobility of the people and rapid rural change.
2. This is very important step for land reforms through which needs of landlord as well as lease holder have been taken care.
3. Through this Act, the landlord can legally lease the land with mutual consent for agriculture and allied activities. In this Act, it has been taken care that in any circumstances, the leased holders' claim on land will not be valid.
4. Lease holder can receive institutional loan, insurance and disaster relief so that he may invest more and more in agriculture.
5. It allows automatic resumption of land after the agreed lease period without requiring any minimum area of land to be left with the tenant even after the termination of tenancy, as laws of some states require.
6. It incentivise tenants to make investments in land improvement and also entitle them to get back the unused value of investment at the time of termination of tenancy.
7. In order to resolve the dispute between the landlord and lease holder, the provision of "Special Land Tribunal" has been made in the civil court.

Model Agriculture Land Leasing Act ensures **the following benefits to the farmers:**

1. Protects land owners from illegal occupation by tenant farmers.
2. Helps tenant farmers get bank loans using leasing agreement as proof.

2.3 SEEDS

Seed sector in India consists of two national level corporations i.e. National Seeds Corporation and State Farms Corporation of India (SFCI), 13 State Seed Corporations (SSCs) and about 100 major seed companies. For quality control and certification, there are 22 State Seed Certification Agencies (SSCAs) and 101 State Seed Testing Laboratories.

The Seeds Act, 1966 provides for the legislative framework for regulation of quality seeds sold in the country. In order to encourage the exports of seeds in the interests of farmers, the procedure for export of seeds have been simplified. Seeds of various crops have been placed under **Open General License (OGL)** except the seeds of wild varieties, germ plasms, breeder seeds and onion seeds which are in restricted list under the Export and Import Policy 2002-07.

Agricultural yield (amount of crop produced in a given acre of land) depends greatly on seed quality. For best yield, hybrid seeds must be replaced every year, and non-hybrid must be replaced every three years. However, **seed replacement in India is less than optimum because:**

1. New seeds are not affordable.
2. High quality seeds are not easily available to all farmers.
3. There is limited research and development in the seed sector. For e.g., the research and investment by private companies remained at a meagre 3-4% of revenue compared to the international norm of 10-12%.
4. There is a regulatory failure in preventing rampant illegal sale and planting of seeds.

Therefore, in order to encourage the seed sector, government has approved **100% FDI in seed development**. Other measures which can be taken to promote the seed sector include steps like strengthening the regulatory mechanism, providing intellectual property rights (IPR) protection to new research and development in this sector, establishing a robust third-party quality certification system for seeds and incentivising private sector in the form of bankable schemes.

2.3.1 NATIONAL SEED POLICY, 2002

National Seed Policy, 2002 was launched to provide intellectual property protection to new varieties, usher this sector into planned development, protect the interests of farmers and encourage conservation of agro-biodiversity.

The policy had **following thrust areas:**

1. Varietal development and plant varieties protection
2. Seed production
3. Quality assurance
4. Seed distribution and marketing
5. Infrastructure facilities
6. Transgenic plant varieties
7. Import of seeds and planting materials
8. Export of seeds
9. Protection of domestic seeds

The **key initiatives** announced in this policy were:

1. A **Plant Varieties and Farmers' Rights Protection Authority** will be established which will undertake registration of extant and new plant varieties.
2. A **National Gene Fund** will be established for the implementation of the benefit sharing agreement and payment of compensation to the village communities for their contribution to the development and conservation of plant genetic resources. The fund will also promote conservation and sustainable use of genetic resources.
3. Plant genetic resources for food and agriculture crops will be permitted to be accessed by research organizations and seed companies from public collections as per the provisions of the 'Material Transfer Agreement' of the International Treaty on Plant Genetic Resources.
4. **National Seeds Board (NSB)** will be established in place of the existing Central Seed Committee and Central Seed Certification Board.

2.3.2 NATIONAL SEED PLAN

The National Seed Plan was aimed at ensuring seed replacement rate of 25% for self-pollinated crops, 35% for cross-pollinated crops and 100% for hybrids for achieving higher productivity.

2.3.3 DRAFT SEED BILL, 2019

Key provisions of the draft seed bill are as follows:

1. It provides for the formation of **Seed Committee** that will be responsible for the effective implementation of its provisions.
2. All varieties of seeds for sale have to be registered and are required to meet certain prescribed minimum standards.
3. **Licensing norms** have been revised. Now, there will be a differentiation between the seed producer, seed processor and seed dealer for the purpose of licensing.
4. Currently, a large percentage of seed is sold under a self-certification programme called "Truthfully Labelled (TL)" seeds. The **certification process has been kept voluntary**.
5. The bill empowers government to **fix the prices of selected varieties** in case of 'emergent' situations like seed shortage, monopolistic pricing, profiteering etc.

2.3.4 PROTECTION OF PLANT VARIETIES AND FARMERS' RIGHTS (PPV&FR) ACT, 2001

India as a signatory to the World Trade Organization (WTO) in 1994, was obliged under Article 27(3)(b) of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), either to adopt a sui generis system for plant variety protection or join the Convention of the International Union for the Protection of New Varieties of Plants (UPOV). The PPV&FR Act, 2001 was enacted by adopting the sui generis system. Indian Patents Act does not give patent to seeds/plant varieties, but the **PPV&FR Act grants Intellectual Property Rights (IPR) to plant breeders, researchers and farmers** who have developed any new plant varieties.

The aim of the act is the establishment of an effective system for the protection of plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants. The act establishes **Protection of Plant Varieties and Farmers' Rights Authority under the Ministry of Agriculture and Farmers Welfare**. It also establishes **Plant Varieties Protection Appellate Tribunal (PVPAT)** which shall dispose of the appeal within one year and whose decisions can be challenged in the High Court.

Rights under the PPV&FR Act are as follows:

1. **Breeders' rights:** Breeders (seed producers) will have exclusive right to produce, sell, market, distribute, import or export the protected variety.
2. **Researchers' rights:** Researcher can use any of the registered variety under the act for conducting an experiment or research. However, repeated use needs prior permission of the registered breeder.
3. **Farmers' rights:** A farmer can save, use, sow, re-sow, exchange, share or sell his farm produce including seed of a variety protected under the PPV&FR Act, 2001. However, the farmer shall not be entitled to sell branded seed of a variety protected under the PPV&FR Act, 2001. There is also a provision for compensation to the farmers for non-performance of variety. The farmer

shall not be liable to pay any fee in any proceedings before the Authority or Registrar or the Tribunal or the High Court under the Act.

2.3.5 SEED BANK/SEED VAULT

The core objective of a seed bank is to make available seeds for contingent situations, develop infrastructure for seed storage and to preserve the genetic diversity.

Svalbard Global Seed Vault located in Norway is a state of art seed protection facility, famously called 'Doomsday' or the 'Apocalypse Seed Bank' or the 'Noah's Ark for Seeds'.

India's Seed Vault is located at Chang La, Ladakh. It has been built jointly by Defense Institute of High-Altitude Research (DIHAR) and the National Bureau of Plant Genetic Resources (NBPGR) under the aegis of DRDO.

2.3.6 SEED VILLAGE

As per the New Seed Policy 2002, '**The Seed Village Scheme**' will be promoted to facilitate production and timely availability of seeds of desired crops/varieties at the local level. Groups of farmers in a village are given training to produce seeds of various crops so that they can fulfil seed demand of their own and neighbouring villages.

2.3.7 GREEN REVOLUTION AND SEEDS

Green Revolution refers to large increase in food production with the help of **High Yielding Varieties (HYV) of hybrid seeds**. MS Swaminathan was the man behind the revolution. It strengthened agricultural research and technology that helped to increase agricultural productivity in the developing nations.

The first phase of the Green Revolution was started in mid-1960 and ended in the mid-1970. Two semi-dwarf wheat varieties of Mexican origin, namely Lerma Rajo and Sonora-64 were released for cultivation in irrigated areas. These varieties resulted in high yields and brought about a wheat revolution in India. In this time phase, the application of HYV seeds were limited to states like Punjab, Tamil Nadu, Andhra Pradesh etc. and mainly benefitted wheat production. The second phase of the Green Revolution was started in 1970 and ended in 1980. The HYV seeds got a nationwide extension and most of the crops were benefitted.

Green Revolution had **several positive impacts** like:

1. **Production and productivity** have increased.
2. **Agricultural exports** from India has expanded.
3. The employment generation in the agriculture sector also increased due to adoption of new technology.
4. New technology and **modernization of agriculture** have strengthened the linkages between agriculture and industry.
5. It has helped create numerous strains of plants that are resistant to pests and diseases. It makes farmers more **secured financially**.

However, there has been **several disadvantages of the Green Revolution** like:

1. The hybrid crops have created **environmental impacts** like soil pollution, water pollution etc. due to excessive fertilizers and pesticides needed by these crops.

2. Increased production of rice and wheat as a result of the revolution led to **over-exploitation of groundwater** as such crops are water demanding in nature.
3. Increase in productivity of crops like rice has led to more stubble being generated which has to be burned before planting new crops. This has created the **crisis of air pollution** in the northern regions.
4. There has been **displacement of agricultural labourers** by extensive use of agricultural machinery and left them unemployed.
5. Green Revolution increased the demand for agricultural credit as huge investment was required for acquiring new technology. **Poor farmers** were thus put at a **disadvantage** as they were not able to get loans easily.
6. The application of HYV seed was **limited to certain states** and that is why other states missed the benefit of modern technology.
7. The **benefits of large farmers** was higher than small and marginal farmers as large farmers had the necessary capital required to invest on the new technology.

Biofortification is the idea of breeding crops to increase their nutritional value. This can be done either through conventional selective breeding or through genetic engineering.

1. **Golden rice** is a genetically modified variety of rice developed by the Philippines-based International Rice Research Institute (IRRI). The presence of beta-carotene pigment in the rice is the reason for its golden colour. Golden rice has been developed to fight Vitamin A deficiency in humans.

The government introduced **Green Revolution-Krishonnati Yojana** in 2005 to boost the agriculture sector. It comprises of 11 schemes and missions under a single umbrella scheme:

1. **Mission for Integrated Development of Horticulture (MIDH)**
 - a. Promote the growth of horticulture sector.
 - b. Enhance horticulture production.
 - c. Improve nutritional security.
 - d. Provide income support to farm households.
2. **National Food Security Mission (National Mission on Oil Seeds and Oil Palm (NMOOP) was merged under National Food Security Mission)**
 - a. Increase the production of rice, wheat, pulses, coarse cereals and commercial crops, through area expansion and productivity enhancement.
 - b. Restore soil fertility and productivity at the individual farm level.
 - c. Enhance farm level economy.
 - d. Augment the availability of vegetable oils.
 - e. Reduce the import of edible oils.
3. **National Mission for Sustainable Agriculture (NMSA)**
 - a. Promote sustainable agriculture best suited to the specific agro-ecology.
 - b. Promote integrated farming.
 - c. Ensure appropriate soil management.
 - d. Synergize resource conservation technology.
4. **Sub-Mission on Agriculture Extension (SMAE)**
 - a. Strengthen the ongoing extension mechanism of State Governments, local bodies etc.
 - b. Achieve food and nutritional security and socio-economic empowerment of farmers.
 - c. Institutionalize programme planning and implementation mechanism.
 - d. Forge effective linkages and synergy amongst various stakeholders.
 - e. Support HRD interventions.

- f. Promote pervasive and innovative use of electronic/print media, inter-personal communication and ICT tools etc.
5. **Sub-Mission on Seeds and Planting Material (SMSP)**
 - a. Increase the production of certified/quality seeds.
 - b. Increase Seed Replacement Rate (SRR).
 - c. Upgrade the quality of farm saved seeds.
 - d. Strengthen the seed multiplication chain.
 - e. Promote new technologies and methodologies used in seed production, processing, testing etc.
 - f. Strengthen and modernize infrastructure for seed production, storage, certification and quality etc.
6. **Sub-Mission on Agriculture Mechanization (SMAM)**
 - a. Increase the reach of farm mechanization to small and marginal farmers and to regions where power availability is low.
 - b. Promote Custom Hiring Centres (CHCs) to offset the adverse economies of scale arising due to small landholding and high cost of individual ownership.
 - c. Create hubs for high-tech and high value farm equipment.
 - d. Create awareness among stakeholders through demonstration and capacity building activities.
 - e. Ensure performance testing and certification at designated testing centres located all over the country.
7. **Sub-Mission on Plant Protection and Plant Quarantine (SMPPQ)**
 - a. Minimize loss to quality and yield of agricultural crops from the ravages of insects, pests, diseases, weeds, nematodes, rodents, etc.
 - b. Shield our agricultural bio-security from the incursions and spread of alien species.
 - c. Facilitate exports of Indian agricultural commodities to global markets.
 - d. Promote agricultural practices, particularly with respect to plant protection strategies.
8. **Integrated Scheme on Agricultural Census, Economics and Statistics (ISACES)**
 - a. Undertake agriculture census and study the cost of cultivation of principal crops.
 - b. Undertake research studies on agro-economic problems in the country.
 - c. Fund conferences/workshops and seminars involving eminent economists, agricultural scientists and experts and to bring out papers to conduct short term studies.
 - d. Improve agricultural statistics methodology and create a hierarchical information system on crop condition from sowing to harvest.
9. **Integrated Scheme on Agricultural Cooperation (ISAC)**
 - a. Provide financial assistance for improving the economic conditions of cooperatives, remove regional imbalances and to speed up cooperative development in agriculture marketing, processing, storage, computerization and weaker section programs.
 - b. Help cotton growers fetch remunerative price for their produce through value addition besides ensuring supply of quality yarn at reasonable rates to the decentralized weavers.
10. **Integrated Scheme on Agricultural Marketing (ISAM)**
 - a. Develop agricultural marketing infrastructure.
 - b. Promote innovative and latest technologies and competitive alternatives in agriculture marketing.
 - c. Provide infrastructure facilities for grading, standardization and quality certification of agricultural produce.
 - d. Establish a nationwide marketing information network.

- e. Integrate markets through a common online market platform to facilitate pan-India trade in agricultural commodities etc.
11. **National e-Governance Plan (NeGP-A)**
 - a. Bring farmer centricity and service orientation to programs.
 - b. Enhance the reach and impact of extension services.
 - c. Improve access of farmers to information and services throughout crop-cycle.
 - d. Build upon, enhance and integrate the existing ICT initiatives of Centre and States.
 - e. Enhance efficiency and effectiveness of programs through making available timely and relevant information to the farmers for increasing their agricultural productivity.

Need for Second Green Revolution

India needs a second Green Revolution due to the following reasons:

1. To address the **food and nutrition demands** of growing population, thus ensuring food security.
2. To increase the **agricultural growth rate** which has become stagnant.
3. To increase **agricultural productivity** in the light of climate change and associated extreme events like droughts.
4. To support our rural population who are mainly dependent on agriculture.
5. To bring about an agricultural transformation in **Eastern India** which are yet to benefit from the first Green Revolution.
6. To ensure **high agricultural productivity** in rain-fed areas, which has a high contribution to our country's total food production, unlike the first Green Revolution which benefitted mainly the irrigated areas.
7. To ensure that the mistakes from the first Green Revolution, like polluted ground waters, overuse of fertilizers etc. are not repeated and environmental sustainability is kept in mind.

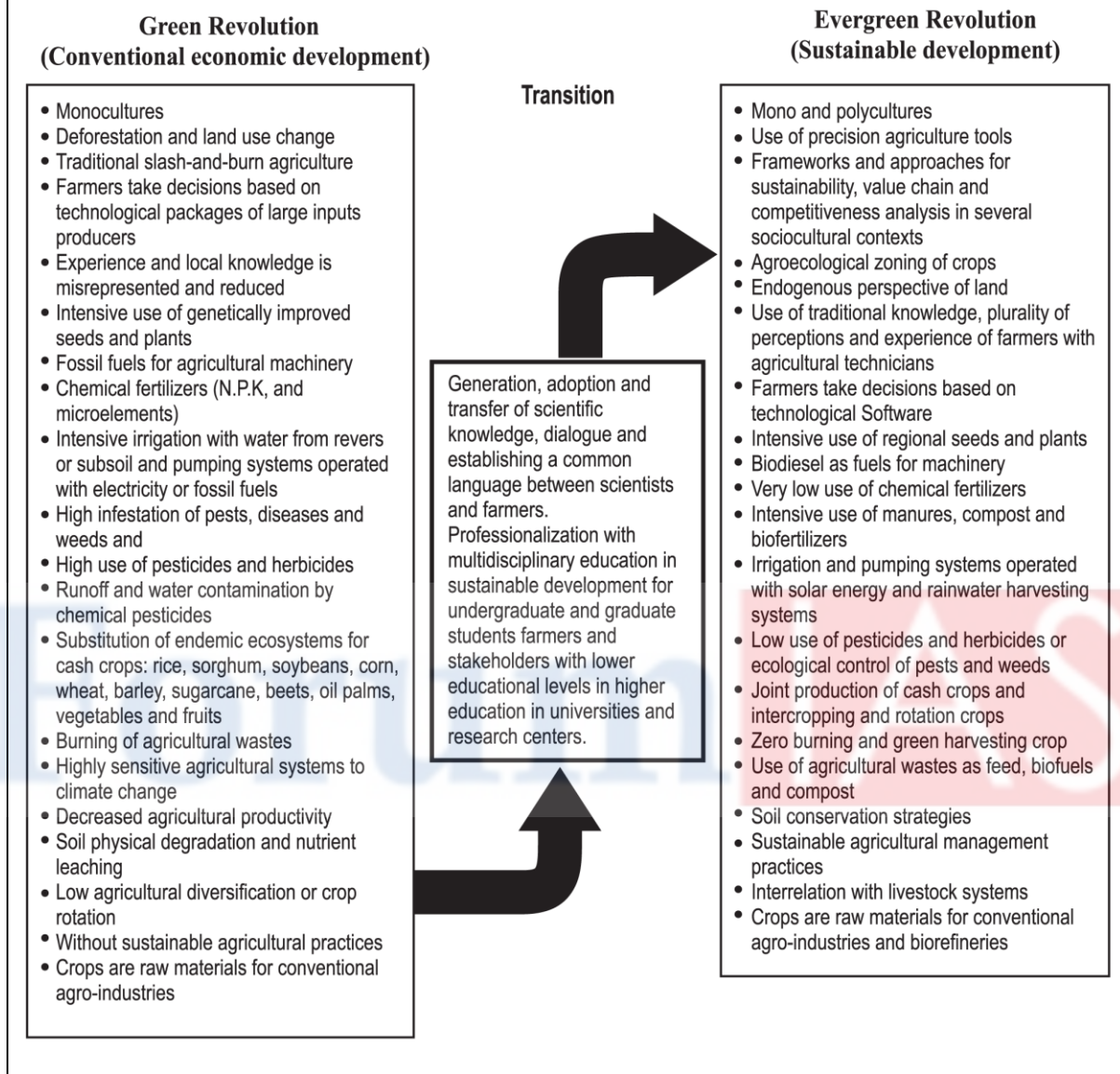
In order to make Second Green Revolution a success, following steps can be undertaken:

1. **Sustainable agricultural practices** needs to be followed like organic farming, zero budget natural farming etc.
2. Keeping climate change in mind, **drought-resistant, flood resistant and salinity tolerant crops** needs to be cultivate. For e.g., The Pokkali rice grown along coastal Kerala is a traditional salt-tolerant variety.
3. Expansion of **agricultural credit** is needed so that farmers could invest in agricultural mechanization.
4. **Precision agriculture** needs to be encouraged. For e.g., drones can be used to spray pesticides and fertilizers, soil health should be measured so that agricultural inputs are provided based on the soil condition etc.
5. **Expansion of irrigation network** should be done so as to reduce dependency on monsoons which are highly uncertain.
6. **Training activities** should be undertaken for farmers to make them aware of best agricultural practices.

Evergreen Revolution

Evergreen Revolution refers to productivity improvement in perpetuity without ecological and social harm. The evergreen revolution involves integration of ecological principles in technology development and dissemination.

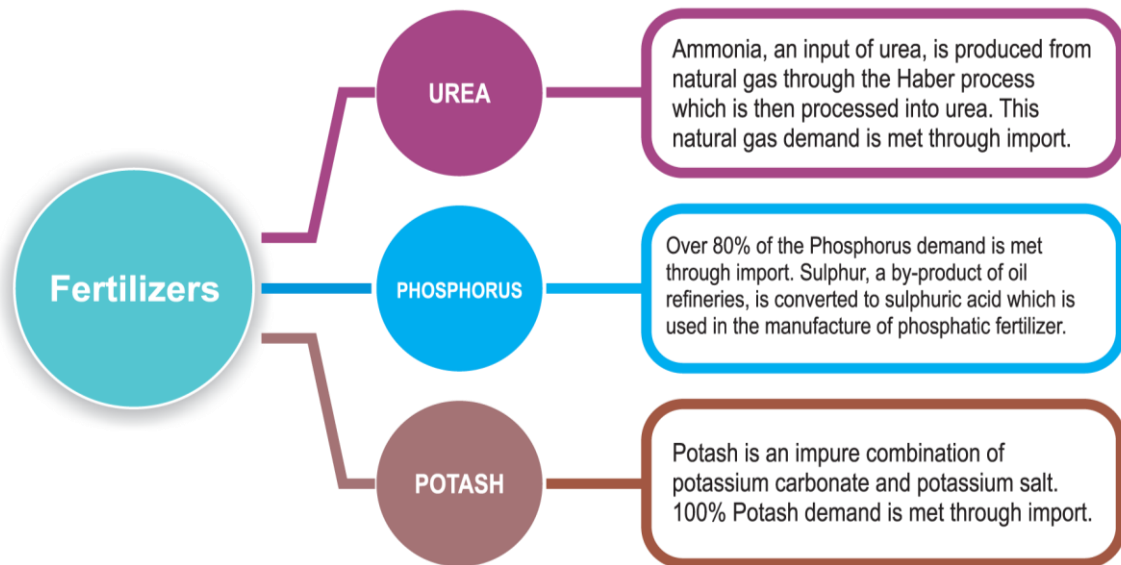
It is focussed sharply on producing more from less land and with lower use of water and at reduced overall costs. This may be possible by integrating traditional systems of farming with the modern and scientific ways of agriculture. The use of chemical fertilizers should be strictly need-based as determined by the requirement of the crop and land fertility.



2.4 FERTILIZERS

Fertilizer is any material of natural or synthetic origin that is applied to soil or to plant tissues to supply one or more plant nutrients essential to the growth of plants. Nutrient content is higher in fertilizers than organic manure and is released immediately into the soil for uptake by the plants.

Fertilizers can be classified into three categories namely- **Primary, Secondary and Micronutrients**. Primary fertilizers are further classified into nitrogenous (urea), phosphatic (di-ammonium phosphate (DAP)) and potassic (muriate of potash (MOP)) fertilizers. Secondary fertilizers include calcium, magnesium and sulphur while micronutrients include iron, zinc etc.



Indian Fertilizer Industry

1. India is the second largest consumer of urea fertilizers after China and also ranks second in the production of nitrogenous fertilizers.
2. Fertilizer industry is one of the eight core industries.
3. Fertilizer subsidy burden remains high, and India spent nearly Rs 80,000 crore on fertilizer subsidy in 2018.
4. In India, the NPK ratio stands at 6.7:2.4:1 as against an ideal ratio of 4:2:1, showing a skewed trend towards nitrogen (urea) consumption.

“**Fertigation**” is the injection of fertilizers, used for soil amendments, water amendments and other water-soluble products into an irrigation system. There are several advantages of fertilizers like controlling the alkalinity of irrigation water is possible, increasing the availability of nutrients to the plants and reducing the leaching of chemical nutrients into the soil.

Herbigation is the recent technique in which herbicides applied through irrigation water. The application of agro inputs like fertilizer through irrigation is practiced for decades and has preceded such technologies with herbicides. Conventional method of application of herbicides is difficult and person applying this is exposed to chemicals and in some instances failed to suppress the growth of target weeds and in addition spray drift is the major problem in it. To avoid such problems, herbigation through micro irrigation controls the target weeds excellently and it is the safe and eco-friendly method of herbicide application.

Biofertilizer (also bio-fertilizer) is a substance which contains living micro-organisms which, when applied to seeds, plant surfaces, or soil, colonize the rhizosphere or the interior of the plant and promotes growth by increasing the supply or availability of primary nutrients to the host plant. Examples of biofertilizer are rhizobium, azotobacter, azospirillum, mycorrhiza, and phosphate solubilizing bacteria.

General issues with the fertilizer sector in India

1. Fertilizer consumption in India is **highly skewed towards urea** due to growing price difference between urea and other fertilizers.

2. **Overuse of fertilizer** has negative impact on the environment. For e.g., excessive use of nitrogenous fertilizers can increase the acidity of the soil and leaching of nitrate into the ground water can also take place.
3. **Urea import is canalised**, meaning that the importers of urea needs to channelize it through the public sector. This causes inefficiencies like delays in imports which leads to unavailability of fertilizers around planting seasons when the need is most crucial.
4. **Black marketing** of urea is rampant, which puts small farmers at a disadvantage due to higher costs.
5. Urea subsidy also suffers from **leakages** and around 36% of the subsidy is lost through leakage to the industry or smuggled across borders.
6. **Delays in subsidy release** puts strain on the fertilizer companies and makes them unsustainable.
7. The fertilizer sector suffers from **over-regulation**. As the government controls the price of urea, fertilizer companies have no incentive to lower the cost of production, thus leading to production inefficiency.

The government passed the Fertilizer Control Order in 1957 to regulate the sale, pricing and quality of fertilizer. Movement Control Order was added in 1973 to regulate the distribution of fertilizer. No subsidy was paid on fertilizer before 1977. However, following the oil crisis in 1973 and the resulting increase in food prices, the government intervened by subsidizing fertilizer manufacturers in 1977.

2.4.1 NUTRIENT BASED SUBSIDY (NBS)

NBS is a Central Sector Scheme started by **Ministry of Chemical and Fertilizers** in 2010. Under the scheme, subsidy is given to fertilizer company based on the weight of different nutrients (Nitrogen, Phosphorus, Potassium and Potash) contained in the fertilizer. Apart from this, fertilizers fortified with secondary and micronutrients are given additional subsidy.

NBS scheme is used to determine the Phosphorus and Potassium (P&K) subsidy, which in turn is based on factors like exchange rate, international and domestic prices of P&K fertilizers, inventory level etc. It is to be noted that **Urea has been kept out of the NBS scheme** and a separate Urea subsidy is provided by the government.

NBS scheme was brought in to increase the consumption of P&K fertilizers and check the overuse of urea, thus ensuring balanced fertilization. The scheme was also aimed at increasing the agricultural productivity, supporting indigenous fertilizer industry and reducing the fertilizer subsidy burden.

2.4.2 UREA SUBSIDY

Urea subsidy is a Central Sector Scheme of the **Department of Fertilizers**. The **New Urea Policy-2015 (NUP-2015)** has been notified by the Department of Fertilizers, extended till 2019-20, with the objective of maximizing indigenous urea production, promoting energy efficiency in urea production and rationalizing subsidy burden on the government. It is applicable to the existing 25 gas based units.

Urea is the **only controlled fertilizer** and is sold at statutorily notified sale price. On the other hand, P&K fertilizers are decontrolled and is sold at indicative MRPs.

2.4.3 OTHER INITIATIVES

1. **Indicative Pricing:** To be eligible for urea subsidy, companies should not sell other fertilizers above the indicative price.
2. **New Pricing Scheme:** It is a subsidy scheme for urea units based on the prices of feedstock used and the vintage of plants. Government decides the cost of production through surveys. The difference between the cost of production and the selling price is paid as subsidy.

2.4.4 NEEM COATED UREA

Ministry of Chemicals and Fertilizers made it mandatory for fertilizer companies to neem coat the urea before selling it. **Neem coated urea provides the following benefits:**

1. Neem coating **slows down the rate of dissolution** of urea in the soil, helping plants gain more nutrients based on their needs. This in turn improves yield of produce.
2. Neem coating also **reduces pest attacks** as neem is a natural insecticide.
3. Neem coating will **prevent diversion of heavily subsidized urea** towards non-agricultural purposes like chemicals industry and other uses such as making adulterated milk.
4. Collection of neem seeds for making neem coated urea will also help **generate employment in rural areas**.

2.4.5 SOIL HEALTH CARD

Soil health card is a Core Scheme launched in 2015 at Suratgarh, Rajasthan by the Department of Agriculture, Cooperation and Farmers Welfare. The Scheme assists State Governments to issue soil health cards to all farmers in the country. A farmer's land is tested and he is given updated soil health card every two years. The scheme also envisages setting up soil testing labs.

Soil health card provides information to the farmers regarding the nutrient status of their soil. It recommends appropriate dosage of nutrients to be applied for improving soil health and its fertility. The card also advises on which type of crops and irrigation methods will suit his farm depending on his soil health.

Thus, it can help reduce the cultivation cost by application of right amount of fertilizer and also improve crop productivity. As per the National Productivity Council (NPC), the scheme has led to a decrease in the use of chemical fertilizers by 8-10% and increases in crop yield by 5-6%.

Despite the benefits of Soil health card scheme, **it also faces several challenges** like:

1. **Infrastructural issues** like old soil testing labs, non-functional equipment etc.
2. **Human resource related challenges** like lack of trained and skilled manpower for testing soil samples.
3. Also, there is **limited awareness amongst farmers** regarding the benefits of the scheme. Further, many a times, farmers are unable to understand the recommendations of the soil health card.
4. **Miscellaneous challenges** like delays in providing testing reports, non-availability of the recommended fertilizers, language barriers as reports may not be available in local languages.

In order to make the scheme a success, government needs to focus on setting up soil testing laboratories at local levels, initiating skilling programs for developing trained manpower for testing and analysing soil samples and providing financial backup for addressing the infrastructural gaps.

2.4.6 DIRECT BENEFIT TRANSFER (DBT)

Under the Direct Benefit Transfer (DBT), the fertilizer subsidy will be released to the fertilizer companies, instead of beneficiaries, after the sale is made by the retailers to the beneficiaries. However, government is considering a scheme under which farmers will be directly transferred the subsidy for fertilizer purchases through their bank accounts rather than transferring it to fertilizer companies, as it is done in case of LPG subsidies.

DBT in fertilizers sector is highly beneficial as:

1. It can help weed out ghost beneficiaries due to better authentication.
2. It will prevent black marketing of fertilizers.
3. Farmers who will be transferred the subsidy will have a freedom of choice to buy fertilizers as per their need.
4. It will reduce financial burden of state by checking leakages.
5. DBT in this sector is a step towards market based pricing. Earlier, government decided fertilizer price, hence there would be no incentive for fertilizer companies to be efficient and minimize cost.

However, **there are issues with DBT** which need to be addressed like:

1. There are high chances of **inclusion and exclusion errors**.
2. Many a times, the money transferred under DBT is **wasted** in the form of alcoholism etc.
3. DBT might not be successful as there is **insufficient financial inclusion**. Farmers do not have bank account where money can be transferred.
4. DBT requires **Centre-State coordination** which is often lacking as agriculture is a state subject.
5. As DBT will lead to a market based pricing regime for fertilizers, the **price of fertilizers may increase**. Hence, the money transferred under it may become insufficient to buy fertilizers.
6. Different regions, depending on their land data, have different agricultural input requirements and may require different subsidy amount. However, in the absence of comprehensive land data, deciding the subsidy amount will be difficult.
7. Lastly, DBT also suffers from technical issues like **biometric authentication failures**, internet connectivity related challenges, digital illiteracy etc.

Few steps which can be implemented to address the issues with DBT include:

1. **Financial inclusion** needs to be promoted.
2. Forms of authentication other than Aadhar should be made available.
3. **DBT Saathis** should be deployed as the first point of facilitation in accessing the subsidy.
4. There should be a **grievance redressal mechanism** to deal with issues arising from the implementation of DBT.
5. **Digital training** should be given to retailers to operate the Point of Sale (PoS) devices.
6. A nationwide land modernization program should be undertaken to develop a comprehensive land data. Soil Health Cards should be issued accordingly to assess the land status. This will help in ensuring evidence based DBT mechanism where subsidy amount is transferred based on the land requirements.

Other steps to promote the growth of fertilizer sector in India.

1. **Decanalisation of urea imports** is needed which will provide greater freedom and flexibility in the import decisions of urea depending on the demand.
2. Government should gradually shift towards a **market-based pricing regime** for the urea sector.

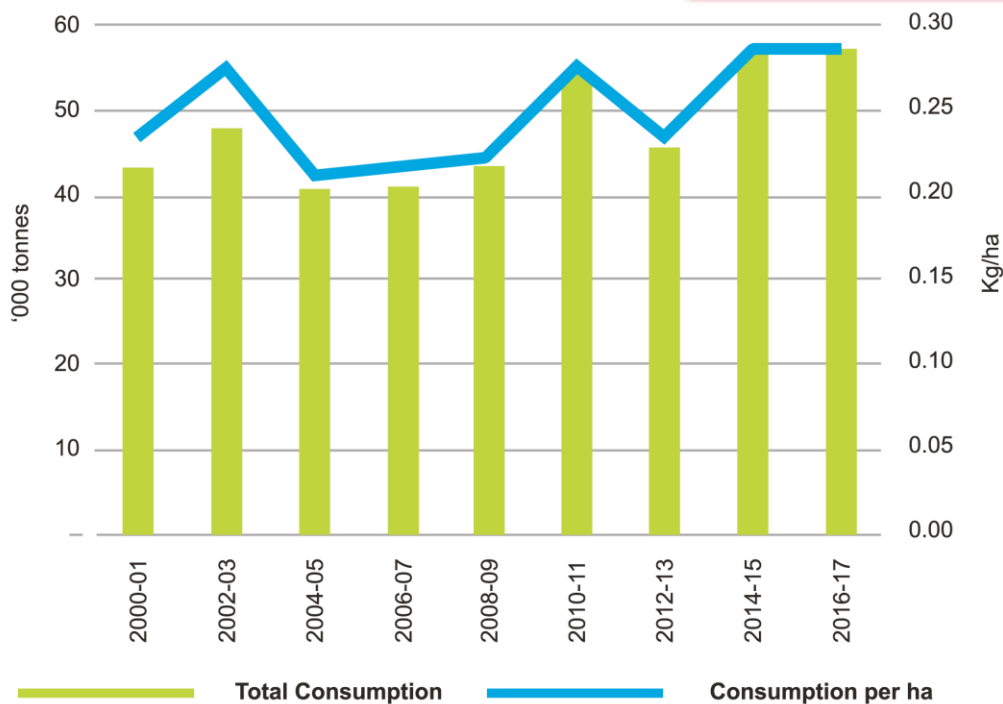
3. **Gas pooling** can be done to ensure that natural gas is supplied in a timely and cost-effective manner to the fertilizer plants.
4. **Extensive supply chains** should be set up to ensure timely availability of fertilizers to the farmers.
5. **Digitization of land records** should be done to ensure timely reach of subsidies to the farmers.
6. An **integrated approach** is the need of the hour, wherein, environmental concerns are kept in mind while encouraging the use of inorganic fertilizers. Soil health card scheme should be implemented at an heightened pace to ensure this. Likewise, organic fertilizers need to be promoted.

2.5 PESTICIDES

Pesticides are substances used to control pests. The term pesticide includes all of the following: herbicides, insecticides, fungicides, etc. Examples of pesticides are:

1. **Neem oil** can be used as pesticide to control the proliferation of some species of insects and mites.
2. **Pyrethrin** is a biodegradable, non-persistent pesticide which is used to kill mosquitos, fleas and other insects.
3. **Carbofuran, Methyl Parathion, Phorate, Monocrotophos, Methyl Demethon, Prophenophos, and Triazophos** are other such examples.

India is the fourth largest producer of pesticide in the world but our per hectare pesticide consumption is far less than the developed countries. Pesticides in India are regulated under the Insecticides Act, 1968 and Insecticide Rules, 1971. Around 290 pesticides are registered in India with the Directorate of Plant Protection, Quarantine and Storage which is an attached office under the Agriculture Ministry.



Trend in pesticide consumption (technical grade) in India

Acts related to pesticides

1. The **Insecticides Act, 1968** regulates the import, manufacture, sale, transport, distribution and use of insecticides and pesticides in order to prevent risk to human beings and animals.
 - a. A **Central Insecticides Board** was established under Section 4 of the Act and it works under the administrative jurisdiction of the Ministry of Agriculture and Farmers' Welfare. The role of the board is to advise governments on matters related to the administration of the Act.

2. The **Pesticides Management Bill, 2020** has the following provisions:
 - a. Pesticide data will be made openly available to the farmers in digital format in all languages. It will help farmers understand the strengths and weaknesses of pesticides, the risk and alternatives.
 - b. A central fund will be created to provide compensation in case of any loss due to low quality of pesticides.
 - c. Promotion of organic pesticides will be undertaken.
 - d. All pesticide manufacturers will be registered and bound by the Act.

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For e.g., canola oil and baking soda have pesticidal applications and are considered biopesticides. Bacteria, fungi and flowering plants can also be employed as biopesticides. Biopesticides are not hazardous to human health, and they are essential to maintain the biodiversity of an ecosystem.

Weeds are important biotic constraint to food production. Weeds compete with crops for the same resources, basically water, nutrients, light, and carbon dioxide. Furthermore, they are alternate hosts for crop pests and pathogens. Moreover, some of them lack autotrophy and fully develop only by parasitizing crops or wild hosts. Globalization of trade and weak legislations on weed control in most of the developing countries has favoured spread of Invasive Alien Plants (IAP).

Weeds, in general, precede crops on farming lands and are major yield reducing factors. In ecological terms, most annual weeds are r-strategists, establishing populations with high relative growth rate (r). Thus, they produce numerous viable seeds, and their populations quickly build up, in an exponential pattern. Weed competition with crops reduces agricultural output (quantity and quality) and increases external costs by spreading them across farm boundaries. It is also a major constraint to increased farmers' productivity, particularly in developing countries where weed control claims 20 to 50 % of farmers' time and keep smallholders in a vicious circle of poverty.

Therefore, **weed management** which involves the process of limiting weed infestation and minimizing competition with crops has become especially important. **Weedicides** (chemicals used for killing weeds) can be used in this regard. For e.g., **Glyphosate** is a weedicide/herbicide which is often categorized as a probable carcinogen for humans. Further, methods like digging, pulling, disking, ploughing, and mowing are used for weed control.

Integrated Weed Management (IWM) is another weed management technique based on a combination of preventive, cultural, mechanical, and chemical practices. A single weed control method is not feasible due to the number of different weed species and their diverse life cycles and survival strategies. In addition, controlling weeds with one or two methods provides the weeds a chance to adapt to those practices. In essence, the development of IWM program is based on a few

general principles that can be used at any farm: (i) use agronomic practices that limit the introduction and spread of weeds (preventing weed problems before they start), (ii) help the crop compete with weeds (help 'choke out' weeds), and (iii) use practices that keep weeds 'off balance' (do not allow weeds to adapt).

There are **several issues related with pesticide usage** in India:

1. Instances of **acute toxicity of farmers** due to pesticides are common. Exposure to pesticides can cause a broad range of nervous system symptoms like headache, fatigue etc.
2. Chronic toxicity of pesticides is a big **health threat for consumers**. Pesticides move up the food chain through the process of biomagnification and ultimately reach humans impacting their health. In 2014, the National Crime Records Bureau (NCRB) recorded 7365 cases of pesticide poisoning, out of which 5915 died.
3. Continuous use of pesticides has negatively impacted the **soil health** and reduced agricultural productivity.
4. While agriculture is a state subject, production, education and research are governed under the Insecticides Act, 1968 which is a central act. This often leads to **regulatory hurdles** and center-state conflict.
5. Other issues include black marketing, rampant illegal usage of banned pesticides etc.

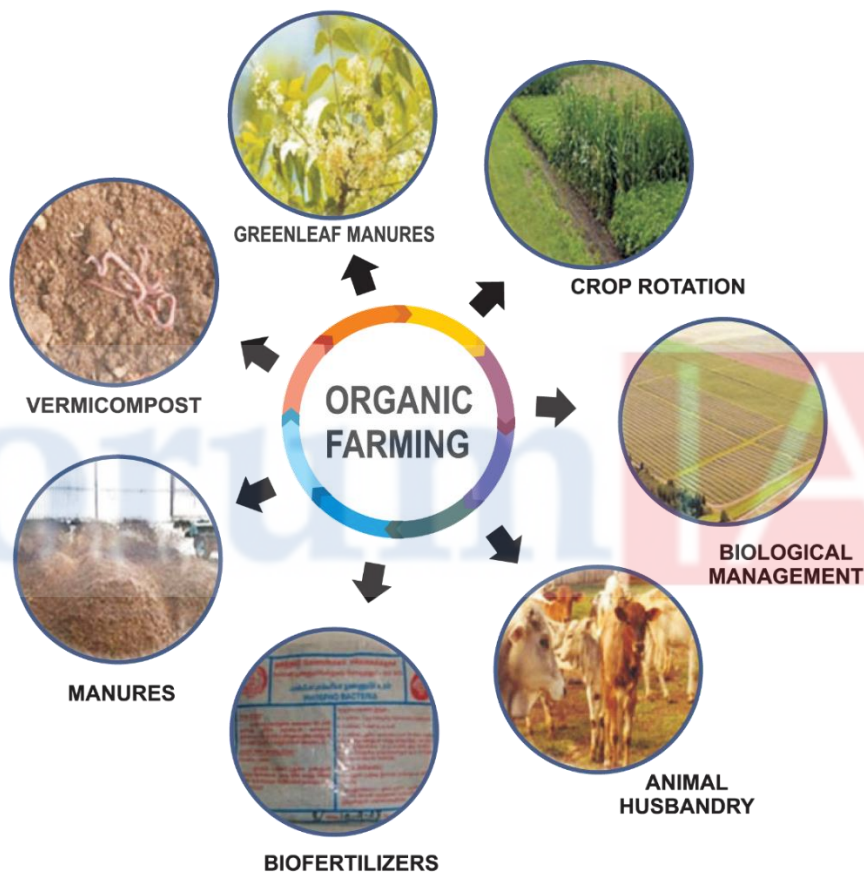
Steps which need to be undertaken to regulate pesticide usage in India:

1. **Capacity building** of farmers needs to be undertaken to make them aware of the judicious use of pesticides.
2. Focus should be on the **minimal use of pesticides**. The aim should be to use pesticides as the last resort.
3. Chemical pesticides should be phased out as soon as possible by providing available alternatives. For e.g., biopesticides could be a plausible alternative.
4. We should adopt **Integrated Pest Management (IPM)** approach. IPM combines biological, cultural and chemical practices to control pests in agricultural production. Natural predators or parasites are used to control pests, and selective pesticides are used only as backup when pests are unable to be controlled by natural means.
5. State governments should have the power to regulate pesticides as they have a better idea about the agro-ecological aspects in their state.
6. Pesticide due to their hazardous nature must not be allowed to be promoted. All kinds of pesticides advertisement should be banned in India.
7. Based on acute toxicity, the World Health Organization (WHO) classifies certain pesticides as extremely hazardous (Class 1a) and highly hazardous (Class 1b). Government should make necessary provisions to ban the sale and use of Class 1 pesticides.
 - a. Government recently banned 18 pesticides based on the recommendations of the **Anupam Verma Committee**. But it left out two heavily used Class I pesticides: Monocrotophos and Carbofuran.
8. Legislative powers must be transferred to the Union Ministry of Health and Family Welfare from the present Agriculture Ministry, to address the health-related concerns related to pesticide usage.
9. Following legislations must be brought to regulate the conduct of pesticide companies:
 - a. It should be made illegal to sell a pesticide by a pesticide company without personal protective equipment or safety gear.

- b. Provision of standard operating procedure (SOP) should be made in cases of acute medical emergencies.
- c. The 'Polluter Pays' principle should be made the basis for fixing liability and compensation from any company.

2.6 ORGANIC FARMING

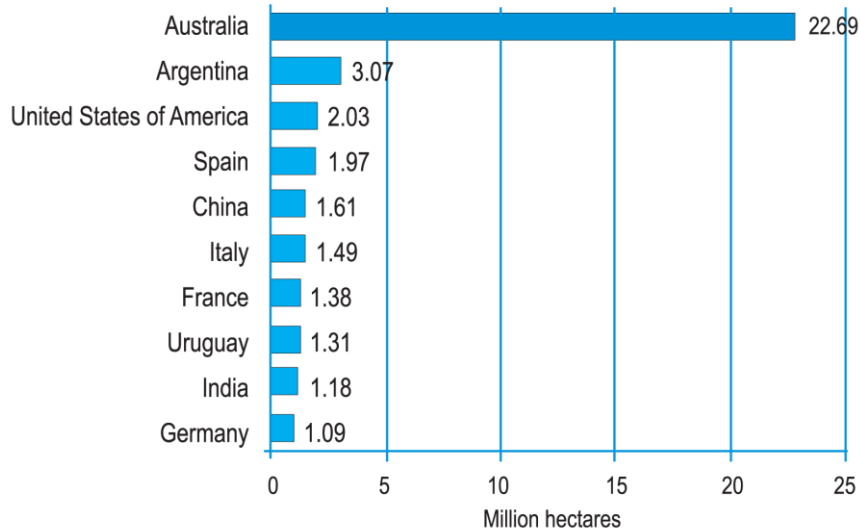
Organic farming is an agricultural system which involves cultivating plants and rearing animals in a natural way. It is a technique which uses biological materials and avoids synthetic substances to maintain soil fertility and ecological balance. Examples of organic manure include fish meal, bone meal, green leaf manuring, oil cakes and compost manure. In 2015, Sikkim became India's first fully organic state.



Status of organic farming in India

India introduced the **organic farming policy in 2005** but it is still in its nascent stage. As per the Ministry of Agriculture and Farmers' Welfare, about 2.78 million hectares of farmland was under organic cultivation as of March 2020 which is 2% of the 140.1 million ha net sown area in the country.

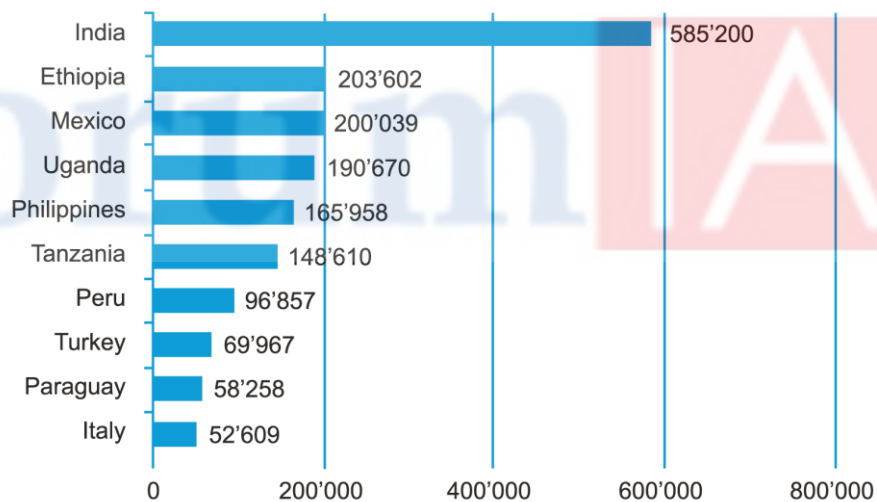
Madhya Pradesh tops the list with 0.76 million ha of area under organic cultivation. The top three states- M.P., Maharashtra and Rajasthan- contribute to about half the area under organic cultivation.



Land under organic farming by countries

(Source: IFOAM and FiBL outlook)

Even though India has a very small area under organic farming, it ranks first in terms of the number of organic farmers.



(Source: IFOAM and FiBL outlook)

Number of producers

Land under organic farming by countries

Organic farming has several benefits compared to fertilizer based conventional agriculture:

1. Uses fewer pesticides which otherwise has a negative impact on the soil health.
2. Reduces soil erosion.
3. Decreases nitrate leaching into the groundwater and surface water.
4. Organically grown crops command higher price in the market, thus increasing farmer's income.
5. Reduces governments fertilizer subsidy burden due to low usage of chemical fertilizers. This in turn can help manage fiscal deficit.

However, **there are certain challenges too associated with organic farming** like:

1. Higher food costs for consumers
2. Yields of organic crops have been found to be about 25% lower overall than conventionally grown crops, although this can vary depending upon the type of crop.
3. Farmers in India lack the requisite skill in organic farming.
4. Good quality organic manure is also not readily available.
5. There is limited market for organically grown crops.

Organic food regulatory system in India

Organic food in India including imports is regulated by the Food Safety and Standards Authority of India (FSSAI). FSSAI is an autonomous statutory body established under the Food Safety and Standards Act, 2006 (FSS Act) which replaced the Prevention of Food Adulteration Act, 1954 Ministry of Health and Family Welfare is the administrative ministry for FSSAI. **Organic food in India is regulated through the following mechanisms:**

1. Participatory Guarantee Scheme (PGS)

PGS is a process of certifying organic products, which ensures that their production takes place in accordance with the laid-down quality standards. The certification is in the form of a documented logo or a statement. PGS emphasizes on the participation of stakeholders, including producers and consumers, and operates outside the framework of third-party certification.

The scheme is implemented by the **Ministry of Agriculture and Farmers' Welfare** and is applicable on on-farm activities like crop production, processing and livestock rearing, etc. Off-farm processing activities such as storage and transport are however not covered.

2. National Programme for Organic Production (NPOP)

NPOP, implemented by **Agricultural and Processed Food Products Export Development Authority (APEDA)** grants organic farming certification through a third party certification process. APEDA is a statutory body under the Ministry of Commerce and Industry. European Commission, Switzerland and USA have recognized NPOP standards as equivalent to their respective accreditation systems.

3. Jaivik Bharat Portal

It is the regulatory portal on organic food in India and has been jointly developed by FSSAI, APEDA, and PGS-India.

4. Jaivik Kheti Portal

It is a portal by the Agriculture Ministry which helps connect organic buyers and sellers with each other.

Zero Budget Natural Farming (ZBNF) is a natural farming developed by Subhash Palekar. It is a type of farming in which there is no use of chemical pesticides and agriculture is carried out in an eco-friendly manner. This helps in restoring soil fertility and organic matter. ZBNF reduces the

cost of production down to zero due to utilization of all the natural resources available in and around the crops.

“**Paramparagat Krishi Vikas Yojana (PKVY)**”, launched by the Agriculture Ministry, is an elaborated component of Soil Health Management (SHM) of major project National Mission on Sustainable Agriculture (NMSA). Under PKVY, organic farming is promoted through adoption of organic village by cluster approach and PGS certification.

2.7 WATER

Water is a critical input for agricultural production and plays an important role in our food security. Irrigated agriculture represents 20% of the total cultivated land and contributes 40% of the total food produced worldwide. Irrigated agriculture is, on average, at least twice as productive per unit of land as rainfed agriculture, thereby allowing for more product intensification and crop diversification.

2.7.1 IMPORTANT MINISTRIES AND DEPARTMENTS

1. **Central Water Commission (CWC)** is a premier technical organization of India in the field of water resources and is presently functioning as an **attached office** of the Ministry of Water Resources, River Development and Ganga Rejuvenation.

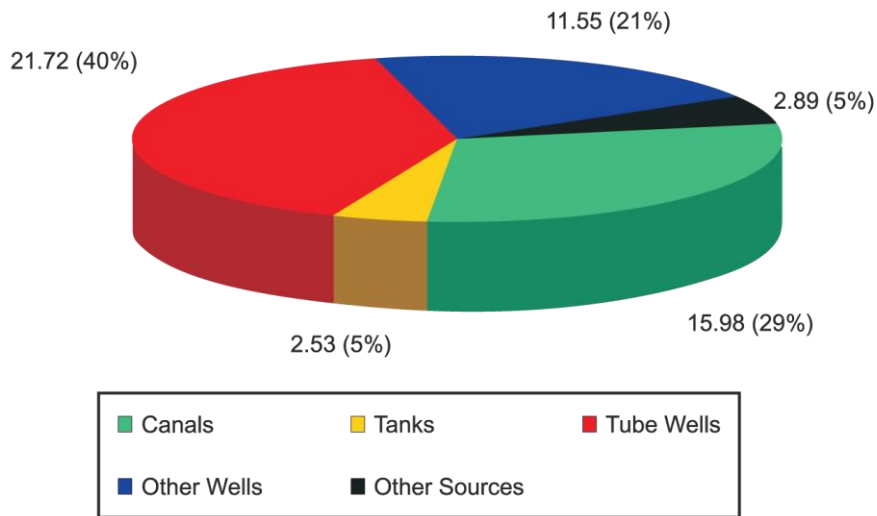
The Commission is entrusted with the general responsibilities of initiating, coordinating and furthering in consultation of the State Governments concerned, schemes for control, conservation and utilization of water resources throughout the country, for the purpose of flood control, irrigation, navigation, drinking water supply and water power development. It also undertakes the investigations, construction and execution of any such schemes as required.

2. **Central Ground Water Authority (CGWA)** is a statutory body constituted under Environment (Protection) Act, 1986. It has the mandate of regulating groundwater development and management in the country.
3. **National Ganga River Basin Authority (NGRBA)** was created in 2006 under the Environment Protection Act, 1986. It has been replaced by the National Ganga Council chaired by the Prime Minister (PM).
4. **Jal Shakti Ministry** was formed in May-2019 by merging two ministries- Ministry of Water Resources, River Development and Ganga Rejuvenation and Ministry of Drinking Water and Sanitation. Now both ministries have been made departments under the Jal Shakti Ministry.

2.7.2 IRRIGATION

Irrigation is the process of applying water to the crops artificially to fulfill their water requirements. Nutrients may also be provided to the crops through irrigation. The various sources of water for irrigation are wells, ponds, lakes, canals, tube-wells and even dams. There are efficient means of irrigation as well like sprinkler irrigation and drip irrigation.

Sources of Irrigation



Wells and Tube-Wells



Well Irrigation

A well is a hole dug in the ground to obtain the subsoil water. An ordinary well is around 3-5 meters while deeper wells goes up to 15 meters deep. Well irrigation is popular in areas where sufficient sweet water is available like great northern plains, deltaic regions of Mahanadi, Krishna, Godavari, Narmada and Tapi valleys.

Problems associated with wells and tube-wells are as follows:

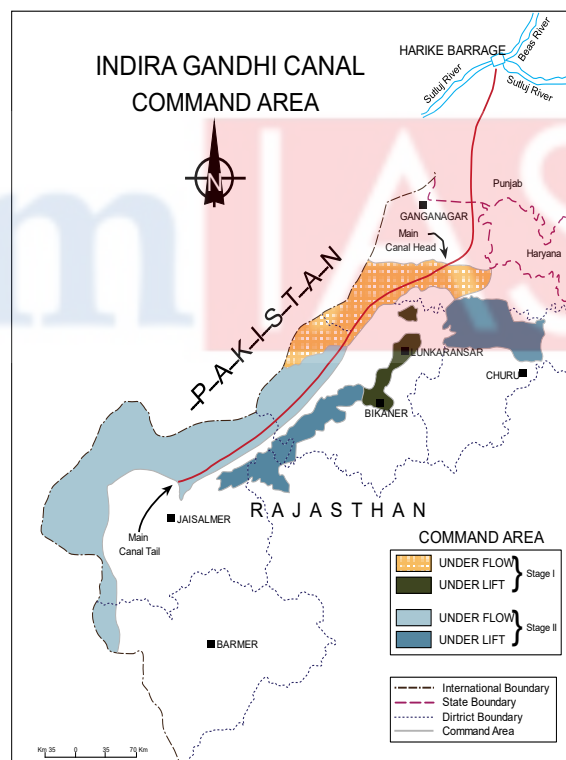
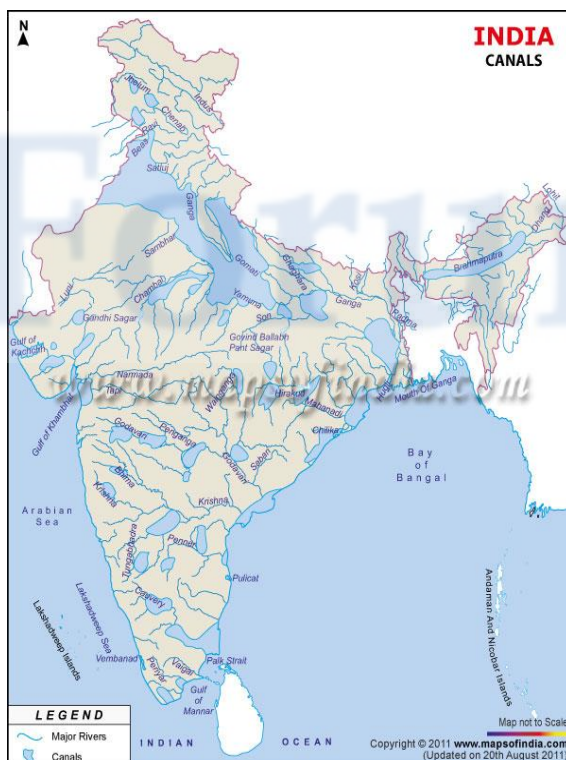
1. Well may dry up in case of water table decline due to over exploitation of ground water resources.
2. Well irrigation is not possible in areas of brackish groundwater.
3. Only a limited area can be irrigated using wells.
4. It is difficult to dig wells in case of hard rock and undulating relief.

Canals



Canal Irrigation

Canal irrigation is the second most important source of irrigation in India. About half of 165.97 lakh hectare land was irrigated by canals during 2008-09 from which half of the irrigated land was concentrated in the Northern plains.



Problems associated with canal irrigation are as follows:

1. Any imbalance in the water distribution process results in a scarcity of water in some areas and water clogging in other areas. Hence, this makes the soil unproductive due to the movement of harmful underground salts and alkali to the surface level.
2. Stationery water present in the canal promotes growth of mosquitoes which becomes a breeding ground of water-borne diseases.
3. Improper maintenance of canals results in the collection of sediments which in turn affects its capacity.
4. Huge time and investment are required in the construction of canals.

Tanks



Irrigation Tank

Irrigation tank or tank is an artificial reservoir of any size and are mainly found in peninsular parts of India.

Problems associated with tank irrigation are as follows:

1. They dry up during the dry season due to evaporation.
2. Tanks occupy huge areas of otherwise cultivable land.
3. Lifting and carrying water from tanks to the field is a strenuous task.
4. Siltation of tanks is also a major issue.

Micro-Irrigation

Micro-Irrigation refers to application of water at low volume and frequent intervals under low pressure to plant root zone. Sprinkler irrigation and Drip irrigation are examples of Micro-Irrigation.

1. **Sprinkler Irrigation:** It is a method of applying irrigation water which is similar to natural rainfall. Water is distributed through a system of pipes usually by pumping. It is then sprayed into the air through sprinklers so that it breaks up into small water drops which fall to the ground.



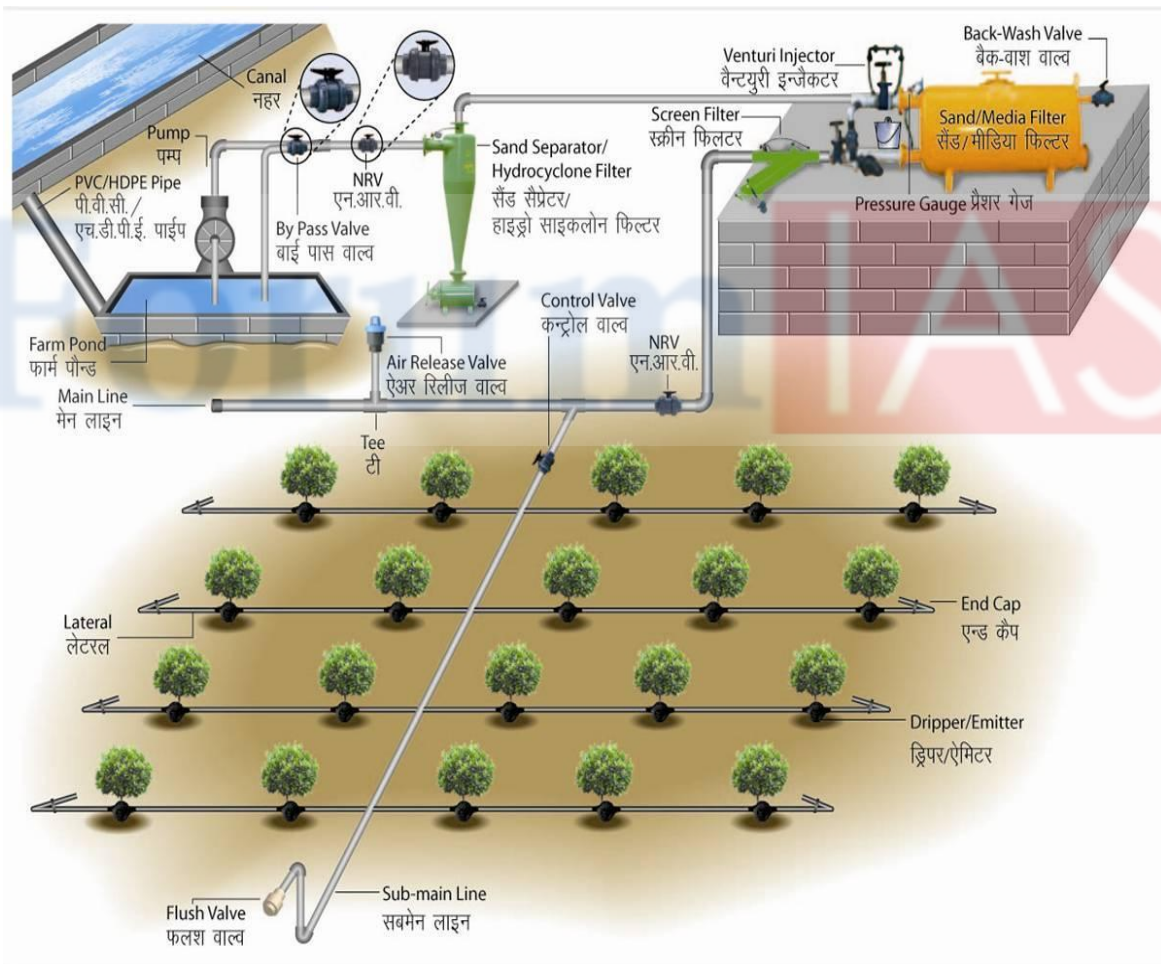
Sprinkler Irrigation

Sprinkler irrigation offers advantages like having the ability to administer fertilizers through the system for even application as well as ensuring that water flows directly to specific areas thus avoiding water loss.

However, **there are certain disadvantages** like:

- a. High initial cost.
- b. Wind interferes with the distribution pattern of water sprays.
- c. Clogged nozzle may interfere with the sprinkler system.
- d. It requires a dependable supply of water.
- e. The method of irrigation is generally more suited to high value crops.

2. **Drip Irrigation:** Drip irrigation is sometimes called triple irrigation and involves dripping water onto the soil at very low rates (2-20 litres/hour) from a system of small diameter plastic pipes fitted with outlets called emitters or drippers. Water is applied close to plants so that only part of the soil in which the roots grow is wetted, unlike sprinkler irrigation, which involves wetting the whole soil profile.



Layout of Drip Irrigation System (ड्रिप सिंचाई पद्धति का रेखाचित्र)

Drip Irrigation

Advantages of drip irrigation are:

- a. Water use efficiency is high.
- b. It reduces soil erosion.

- c. There is high efficiency in the use of fertilizers and there is no runoff of fertilizers into the ground water.
- d. It discourages weed growth as water is delivered close to the plants.
- e. Fungal diseases are minimized as there is minimum water contact with the stems, leaves and fruits of the plant.

However, **there are challenges associated with it** like:

- a. There are issues of clogging.
- b. High cost is required in its installation.
- c. Lack of requisite skill amongst farmers for design, installation and operation.
- d. Salinity issues are present.

Check Basin and Border Strip Irrigation

Surface irrigation involves the application of water by gravity flow to the surface of the field. Over the years many surface methods of irrigation have been developed. Among them, the check basin method of irrigation is the most popular. Check basin is the easiest and least costly method but is highly inefficient as only less than 20% of the water is taken up by the plant. Unfortunately, this is also the most widely used method among Indian farmers in different crops and cropping systems.

Furrow Irrigation

The furrow method of irrigation is generally used to irrigate row crops and vegetables, and is suited to soils in which the infiltration rates are between 0.5 and 2.5 cm/hr. It is ideal for slopes varying from 0.2 to 0.5 percent and a stream size of 1-2 liter/second. Many of the field crops in which water is applied through flooding, check basin or border strip methods, can easily be adapted for furrow irrigation or its modified version, i.e., raised bed system and 20-30% savings in irrigation water can be achieved by switching over to raised bed furrow irrigation systems.

Surge Flow Irrigation

Excessive water intake and deep percolation losses are major limitations for irrigation through furrows and border strips. Surge flow irrigation, the intermittent application of water in a series of on and off modes of constant or variable time spans has the potential of reducing intake and percolation losses, increasing the irrigation efficiencies and conserving irrigation water.

Subsurface Drip Irrigation (SDI)

SDI is a low-pressure, low volume irrigation system that uses buried tubes to apply water. The applied water moves out of the tubes by soil matrix suction. Wetting occurs around the tube and water moves out in the soil in all directions. The potential advantages of SDI are: a) water conservation, b) enhanced fertilizer efficiency, c) uniform and highly efficient water application, d) elimination of surface infiltration problems and evaporation losses, e) flexibility in providing frequent and light irrigations, f) reduced problems of disease and weeds, g) lower pressure required for operations.

Subsurface irrigation is suitable for almost all crops, especially for high value fruit and vegetables, turfs and landscapes. The tube is installed below the soil surface either by digging the ditches or by special device pulled by a tractor. The depth of installation depends upon soil characteristics and crop species ranging from 15-20 cm for vegetables and field crops and 30-50 cm for tree crops. The main disadvantages are the high cost of initial installation and increased possibility for clogging, especially when poor quality water is used.

Deficit Irrigation Practices

In arid and semi-arid regions, water availability is usually limited, and certainly not enough to achieve total crop water requirement and the maximum yields. Then, irrigation strategies should not be based on full crop water requirements but should be adopted for more effective and rational use of water based on the critical or sensitive growth stages to water deficit. Thus, at non-sensitive growth stages irrigation is withheld which is called as deficit irrigation.

Regulated Deficit Irrigation (RDI)

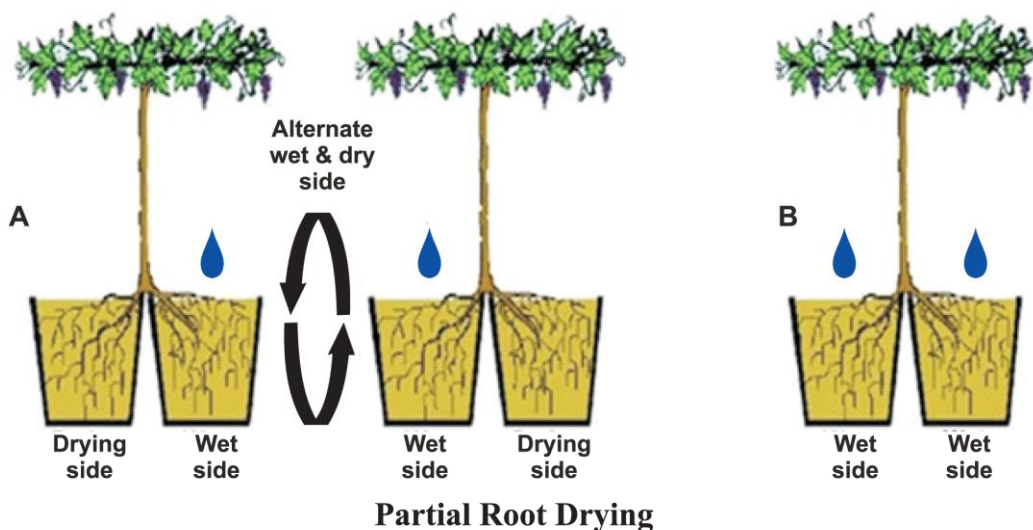
RDI is an optimizing strategy under which crops are allowed to sustain some degree of water deficit and yield reduction. During RDI, the crop is exposed to a certain level of water stress either during a particular period or throughout the growing season. The main objective of RDI is to increase Water Use Efficiency (WUE) of the crop by eliminating irrigations that have little impact on yield and to improve control of vegetative growth (improve fruit size and quality).

RDI is a sustainable way to cope with water scarcity since the allowed water deficit favors water saving, control of percolation and runoff return flows and the reduction of losses of fertilizers and agrochemicals. It provides for leaching requirements to cope with salinity and the optimization approach leads to economic viability. The adoption of deficit irrigation implies appropriate knowledge of crop evapotranspiration, of crop response to water deficits including the identification of critical crop growth stages, and of the economic impact of yield reduction strategies.

Partial Root Drying (PRD)

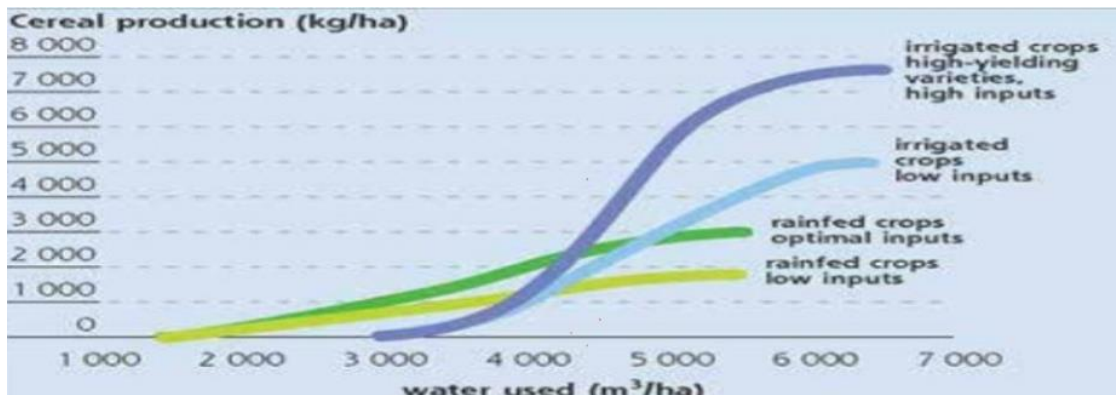
PRD is a new irrigation technique, first applied to grapevines that subject one half of the root system to dry or drying conditions while the other half is irrigated. Wetted and dried sides of the root system alternate on a 7–14-day cycle. PRD uses biochemical responses of plants to water stress to achieve balance between vegetative and reproductive growth.

The PRD has been successfully applied with drip irrigation in grapevines, with subsurface irrigation in grapevines and even furrow irrigation in pear, citrus and grapevines. Improvement of WUE results from partial stomatal closure and reducing evapotranspiration during drying period.



Irrigation is important for agriculture in the following ways:

1. It helps in increasing agricultural productivity and food production which is crucial to meet the food security.



Comparative Yields of Cereals under Rainfed and Irrigated Farming

Source- Food and Agriculture Organization (FAO)

2. It helps counter the spatial and temporal variations in rainfall as well as its uncertainty, irregularity, unreliability and erratic nature.
3. Irrigation maintains moisture in the soil and improves soil health.
4. Irrigation is a must for water intensive crops like sugarcane and jute.
5. Introduction of high yield varieties like Genetically Modified (GM) crops requires high amounts of water which can be supplied through irrigation.

While irrigation is needed to increase agricultural productivity and meet the rising food security needs of the growing population, it is a matter of concern that about 60% of the total cropped area is still dependent on rain. **Irrigation sector in India faces a number of problems** that needs attention like:

1. In most of the irrigation projects, there have been considerable delays in project completion.
2. Irrigation being a state subject, development of water resource is planned individually by states taking into account their own requirements. However, nearly all major rivers are inter-state which often leads to inter-state water disputes.
3. Inadequate on-farm and off-farm infrastructures and poor maintenance leads to poor irrigation efficiency.
4. Regional disparities are also visible in irrigation infrastructure development.
5. Introduction of irrigation has also led to the issue of water logging and salinity in states.
6. Huge investment is required in operating and maintaining irrigation networks, causing financial strain on the governments.
7. Decline in water due to overexploitation of water has affected our irrigation capacity.

To address the challenges, **following irrigation management measures** are required:

1. Building proper infrastructure like canals for adequate and regular water supply.
2. A proper drainage system needs to be put in place for addressing the issue of water logging and salinity in major irrigation commands.
3. Irrigation efficiency needs to be improved through steps like Micro-irrigation.
4. Improving water productivity through steps like: (i) water should be priced at a level enough to motivate farmers to save water, (ii) energy subsidy for pumping water should be abandoned, (iii) biological water-saving measures, engineering solutions, agronomic and soil manipulation should be collectively explored.

5. Water intensive crops should be cultivated in areas with abundant ground water availability. In areas with ground water shortage, drought resistant crops like maize should be grown.

2.7.3 PRADHAN MANTRI KRISHI SINCHAYEE YOJANA (PMKSY)

PMKSY is a national mission under the Ministry of Agriculture & Farmers' Welfare to improve farm productivity and better utilization of the resources in the country. The scheme has been approved with an outlay of 50,000 crore for the period of 5 years (2015-16 to 2019-20). Major objectives of the scheme are:

1. Convergence of investment in irrigation at field level.
2. Expand cultivable area under irrigation.
3. Improve on-farm water use efficiency to reduce wastage of water.
4. Enhance the adoption of being precise in irrigation and other water saving technologies (more crop per drop).

Pardhan Mantri Krishi Sinchayee Yojana District Irrigation Plan - Programme Components



2.7.4 PRADHAN MANTRI KISAN URJA SURAKSHA EVAM UTTHAAN MAHAABHIYAN (PM KUSUM)

PM KUSUM scheme has been launched recently by **Ministry of New and Renewable Energy (MNRE)**. The scheme aims to provide energy security along with financial and water security to farmers. It will encourage farmers to generate solar power in their farms. The target is to add decentralized solar power capacity of 25,750 MW by 2022. Components of KUSUM scheme are:

1. **Component A:** 10,000 MW of decentralized ground mounted grid connected renewable power plants.
2. **Component B:** Installation of 2 million standalone solar pumps.
3. **Component C:** Solarization of 1.5 million grid connected solar powered agricultural pumps.

Farmers can sell surplus solar power generated off-grid to DISCOMS, thereby increasing their incomes.

2.7.5 ATAL BHUJAL YOJANA

Atal Bhujal has been launched by the **Ministry of Jal Shakti**. It is a Central Sector Scheme to improve ground water management through community participation. Seven states are covered under the scheme- Gujarat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh. It is being implemented (starting 2020) over a period of 5 years with 50% support from **World Bank**.

2.7.6 MISCELLANEOUS

Namami Gange Program is an integrated conservation mission under NMCG with a budget outlay of Rs 20,000 crore to accomplish the twin objectives of effective abatement of pollution along with conservation and rejuvenation of Ganga. Initiatives under Namami Gange include:

1. **Ganga Gram Yojana** under which 1600 villages situated along the banks of river Ganga will be developed.
2. **Ganga Task Force** will be created.

Jal Shakti Abhiyan (JSA) is a time-bound, mission-mode water conservation campaign launched by the **Jal Shakti Ministry**. The JSA ran in two phases: Phase 1 from 1st July to 15th September 2019 for all States and Union Territories; and Phase 2 from 1st October to 30th November 2019 for States and UTs receiving the retreating monsoon (Andhra Pradesh, Karnataka, Puducherry and Tamil Nadu).

During the campaign, officers, groundwater experts and scientists from the Government of India will work together with state and district officials in India's most water-stressed districts for water conservation and water resource management by focusing on accelerated development of five target intervention.

Jal Jeevan Mission (JJM) is an initiative by the Jal Shakti Ministry to ensure piped water supply to: (i) all rural households by 2024, (ii) cities with more than a million population in 2020 itself.

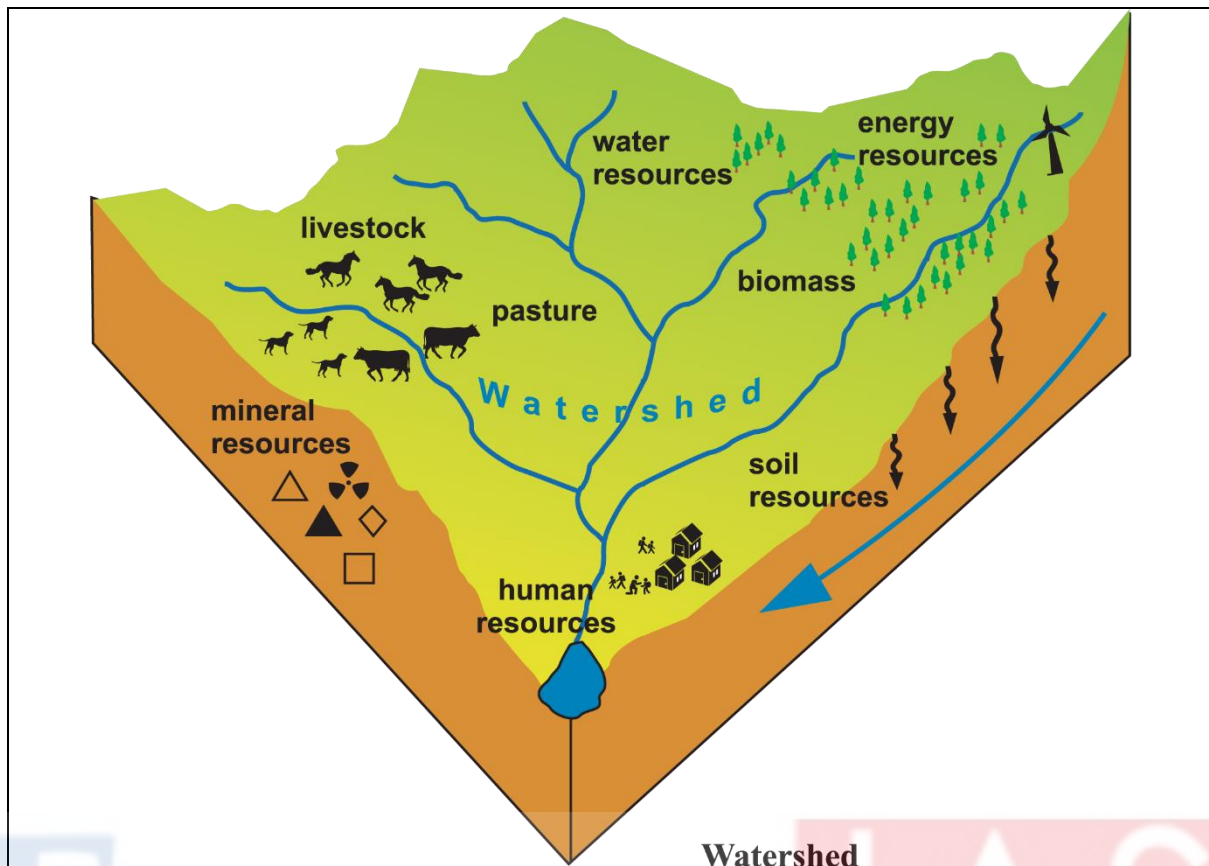
The mission will focus on rainwater harvesting, groundwater recharge and using household wastewater for reuse in agriculture. National Rural Drinking Water Program (NRDWP) will be subsumed under the JJM to ensure convergence of different schemes.

Long Term Irrigation Fund (LTIF) is a fund under National Bank for Agriculture and Rural Development (NABARD) for the implementation of major and medium irrigation projects in India. Under the fund, Rs 20,000 crore is to be raised.

Likewise, **Micro Irrigation Fund (MIF)** with a corpus of Rs 5000 crore has been created under NABARD with the aim of enhancing water use efficiency at farm level.

Watershed Management in India

A watershed is an area of land that drains or "sheds" water into a specific waterbody.



Watershed

National Watershed Project, a World Bank assisted watershed management project, involves conservation, regeneration as well as judicious use of all the resources like land, water, animals, plants and humans within the watershed area.

The National Watershed Project has led to an increase in the agricultural production from water-stressed areas. It has led to a reduction in surface run-off, thus increasing groundwater recharge, soil moisture and better water-availability in water-stressed areas. Optimum utilization of natural resources like land and water has resulted in increasing agricultural productivity and cropping intensity.

Further, the project helped in the restoration of ecological balance in fragile water-stressed areas by increasing vegetative cover and decreasing soil erosion through afforestation. It also helped farmers adapt to climate change and mitigate the adverse effects of drought by adopting sustainable agricultural practices.

Another big achievement of the project is that it has led to community participation in conserving water.

Existential water crisis in India

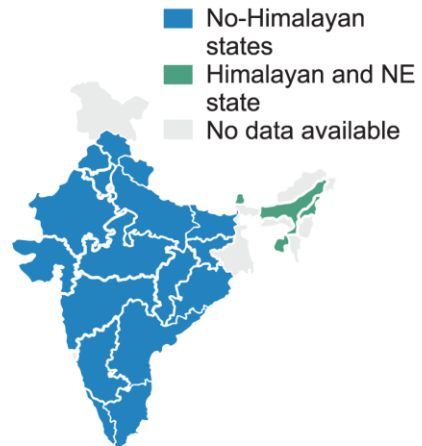
As per the NITI Aayog, we are facing the “**worst water crisis**” in India’s history. It launched the **Composite Water Management Index (CWMI)** to assess and improve the performance of States and Union Territories in the efficient management of water resources. The 2018 CWMI noted that 6% of economic GDP will be lost by 2050, while water demand will exceed the available supply by 2030.

The Index comprises 9 broad sectors covering 28 indicators

Indicator Sectors and weights

No.	Sector	Weights
1	Source augmentation and restoration of waterbodies	5
2	Source augmentation (Groundwater)	15
3	Major and medium Irrigation-Supply side management	15
4	Watershed development-Supply side management	10
5	Participatory Irrigation practices- Demand side management	10
6	Sustainable on-farm water use practices-Demand side management	10
7	Rural drinking Water	10
8	Urban water supply & sanitation	10
9	Policy and governance	15
Total		100

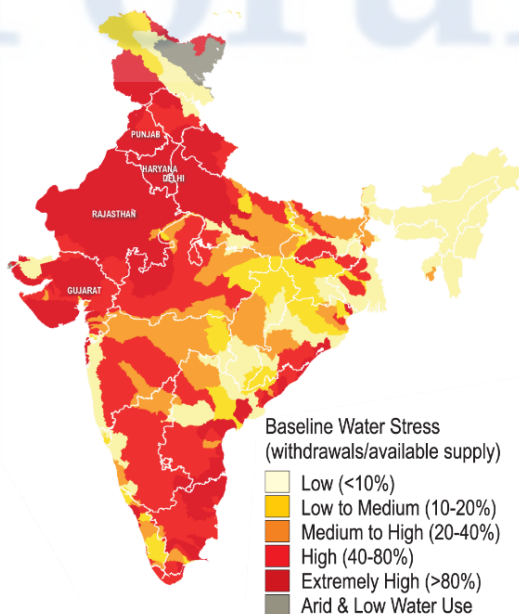
Classification of states into Non-Himalayan and Himalayan



- The nine sectors cover 28 indicators, with the weights equally divided across a sectors indicators
- Focus on groundwater, irrigation and polity action highlighting the growing groundwater india's low irrigation utilization, and the importance of effective polity frameworks
- The reporting states were divided into two special groups - Non-Himalayan states and Himalayan and NE states to account for the different hydrological conditions across these groups
- No data from UTs

Baseline water stress in India

Ratio of total withdrawals and total flow (2010)



Facts: Water supply is limited, quality is poor



600 million people face high-to-extreme water stress.



78% of household do not have drinking water on premise. **84%** rural households do not have piped water access.



70% of our water is contaminated; India is currently ranked **120** among **122** countries in the water quality index.

Owing to its sizable agricultural exports, India has been losing water thereby putting its water sustainability at risk. For example, in 2014-15, India exported 37.2 lakh tons of basmati. To export this rice, the country used around 10 trillion liters of water. To put it in another way, **India virtually exported 10 trillion liters of water.**

Due to the existential water crisis, food supply is also at risk as areas for wheat cultivation and rice cultivation face extreme water scarcity. To address the crisis, government needs to work on steps like groundwater recharging projects, micro-irrigation, and legislative changes to promote water management. Water pricing can be implemented so as to promote judicious use of water. Water tax should be introduced for companies which over-exploit water resources.

Rain-fed Area Development Program (RADP)

Rain-fed Area Development Programme, which adopts a holistic approach to enhance farmers' incomes in rainfed areas, was implemented in 22 states in 2013-14. It was implemented as a sub-scheme under Rashtriya Krishi Vikas Yojana (RKVY) with the following objectives:

1. To improve the quality of life of farmers' especially, small and marginal farmers by offering a complete package of activities to maximize farm returns.
2. Increasing agricultural productivity of rainfed areas in a sustainable manner by adopting appropriate farming system-based approaches.
3. To minimize the adverse impact of possible crop failure due to drought, flood or un-even rainfall distribution through diversified and composite farming system.
4. Restoration of confidence in rainfed agriculture by creating sustained employment opportunities through improved on-farm technologies and cultivation practices.
5. Enhancement of farmers' income and livelihood support for reduction of poverty in rainfed areas.

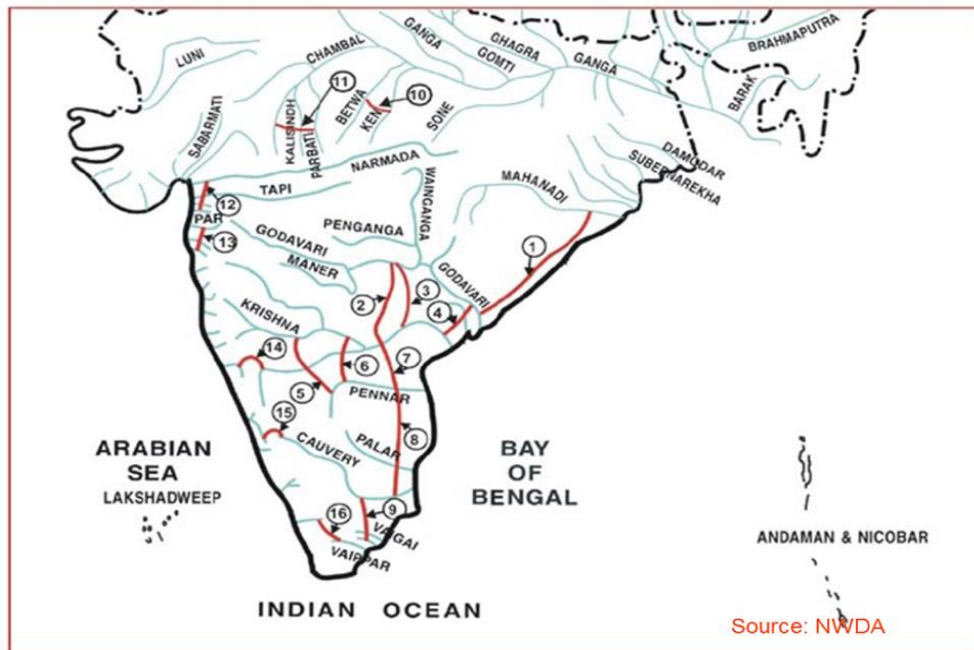
The strategy would focus on multi-cropping, rotational cropping, inter-cropping, mixed cropping along with allied activities that include horticulture, livestock, etc. This would not only maximize farm returns but also mitigate impacts of floods, droughts, etc.

Drought Prone Areas Programme (DPAP)

The basic objective of the programme is to minimize the adverse effects of drought on production of crops and livestock and productivity of land, water and human resources ultimately leading to drought proofing of affected areas. The programme also aims to promote overall economic development and improving the socio-economic conditions of the resource poor and disadvantaged sections inhabiting the programme areas.

River Interlinking Project

PROPOSED INTER BASIN WATER TRANSFER LINKS PENINSULAR COMPONENT



- | | |
|--|---|
| 1. Mahanadi (Manibhadra) – Godavari (Dowlaiswaram) * | 9. Cauvery (Kattalai) – Vaigai – Gundar * |
| 2. Godavari (Inchampalli) – Krishna (Nagarjunasagar) * | 10. Ken – Betwa * |
| 3. Godavari (Inchampalli) – Krishna (Pulichintala) * | 11. Parbati – Kalisindh – Chambal * |
| 4. Godavari (Polavaram) – Krishna (Vijayawada) * | 12. Par – Tapi – Narmada * |
| 5. Krishna (Almatti) – Pennar * | 13. Damanganga – Pinjal * |
| 6. Krishna (Srisailem) – Pennar * | 14. Bedti – Varda |
| 7. Krishna (Nagarjunasagar) – Pennar (Somasila) * | 15. Netravati – Hemavati |
| 8. Pennar (Somasila) – Palar- Cauvery (Grand Anicut) * | 16. Pamba – Achankovil – Vaippar * |
- * FR Completed

The interlinking of rivers project is to transfer water from water surplus rivers to the rivers with deficit water. The project aims to effectively manage the water resources in India by linking Indian rivers by a network of reservoirs and canals to enhance irrigation and groundwater recharge, reduce persistent floods in some parts and water shortages in other parts of India.

However, **there are certain concerns regarding the project** like:

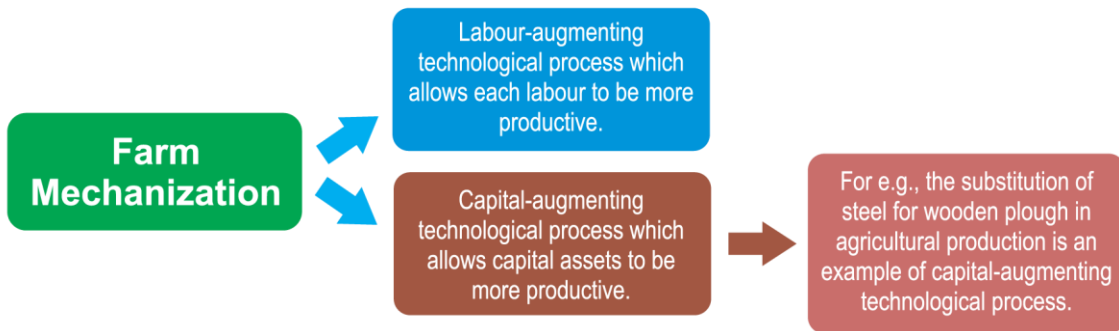
1. Huge investment is required in the project.
2. Ecological and environmental issues are involved in the project like deforestation, desertification, land and forest submergence. For e.g., the Ken-Betwa project will lead to the submergence of the core area of Panna National Park.
3. It will lead to the displacement of people.
4. There will be a big problem of desilting and there is no clarity as to where the silt will be actually dumped.
5. A major issue in India related to interlinking of rivers is that water is a state subject and states that have surplus water are not ready to give it other states.

2.8 FARM MECHANIZATION

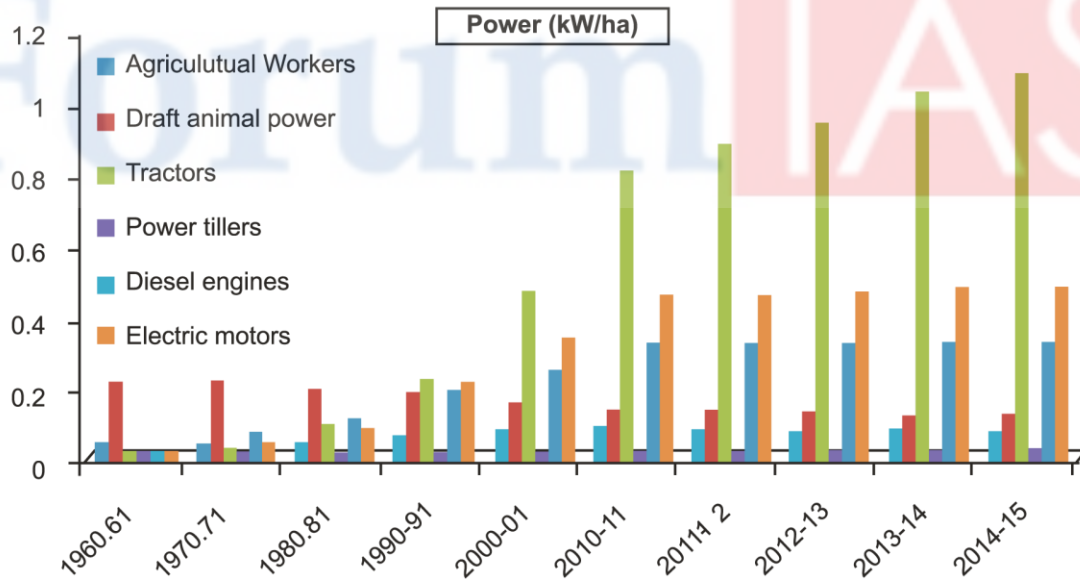
Farm mechanization refers to the use various power sources and improved farm tools and equipment, with a view to reduce drudgery of the human beings and draught animals, enhance the cropping

intensity, precision in metering and placement of inputs and timelines of efficiency of utilization of various crop inputs (seeds, chemical, fertilizer, irrigation, water, etc.) and reduce the losses at different stages of crop production. The end objective of farm mechanization is to enhance the overall productivity and production with the lowest cost of production.

It also helps in the conservation of the produce and byproducts from qualitative and quantitative damages, enhance value addition and establishment of agro processing enterprises for additional income and employment generation from farm produce. It is one of the important inputs to users in all round development in rural India.



Statistics related to farm mechanization



Agriculture mechanization in India

1. Farm mechanization in India has been 40-45% compared to other countries such as USA (95%) and China (57%).
2. Farm mechanization market in India has been growing at a Compound Annual Growth Rate (CAGR) of 7.53% during the year 2016-18.
3. Government is aiming to enhance farm power availability from 2.02 kW per ha (2016-17) to 4.0 kW per ha by the end of 2030.

Government initiatives for farm mechanization

1. **Sub-mission on Agricultural Mechanization:** Sub-mission on agricultural mechanization was launched in April 2014 to promote inclusive growth of farm mechanization to enhance productivity. Under the scheme, individual farmers are provided subsidy for the procurement of farm machinery.
2. **In-situ crop residue management:** Special scheme was created for in-situ management of crop residues in the states of Punjab, Haryana, UP and NCT of Delhi. Machines and equipment for in-situ crop residue management are provided with 50 per cent subsidy to the individual farmers and 80 per cent subsidy for establishment of Custom Hiring Centers.
3. **FARMS-App:** This multi-lingual mobile app platform 'FARMS-App (Farms Machinery Solutions-app)' will facilitate local farmers and citizens of the different states across the country with the custom hiring services of Farm Machinery Banks, Custom Hiring Centers and Hi-Tech Hubs established under the various schemes of Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW), Ministry of Agriculture and Farmers Welfare without any computer support system.

This app will help the individual farmers, willing to provide their agriculture machinery & equipment on rental basis to increase their farm income beside making the optimum utilization of the available agricultural machines available in the CHCs/FMBs/Hi-Tech Machinery Hubs. It will also provide a platform for sale and purchase of old agriculture machinery to farmers also.

4. **Agriculture Infrastructure Fund:** Government announced a Rs. 1 lakh crore Agri Infrastructure Fund for farm-gate infrastructure for farmers. Accordingly, Central Sector Scheme of Financing Facility under Agriculture Infrastructure Fund was approved by the Cabinet.

The scheme will provide a medium-long term debt financing facility for investment in viable projects for post-harvest management infrastructure and community farming assets through interest subvention and financial support.

Agriculture Infrastructure Fund will cover agri-entrepreneurs, startups, agri-tech players, farmers group for post-harvest management and nurturing farm assets.

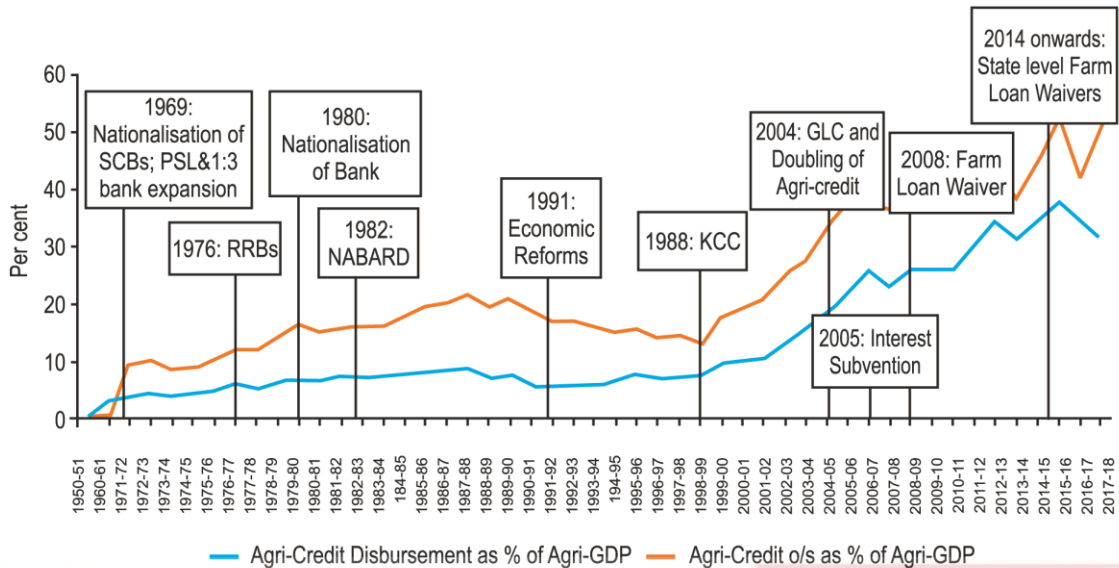
While farm mechanization is an important input to boost agricultural production and productivity, **it is faced with several challenges** like:

1. There is **low overall mechanization** in India compared to countries like USA, China and Brazil. Major reasons being **economies of operation** due to small land holdings, access to power, credit cost and procedures, uninsured markets and low awareness.
2. Small-marginal farmers **lacks financial resources** to own or hire farm machinery.
3. Considering India's soil and climatic diversity, customized machinery suited to Indian requirements is needed. However, there is **limited Research & Development (R&D)** in the agriculture mechanization sector.
4. **Regional disparities** are visible with Northern India having higher levels of mechanization compared to other regions.

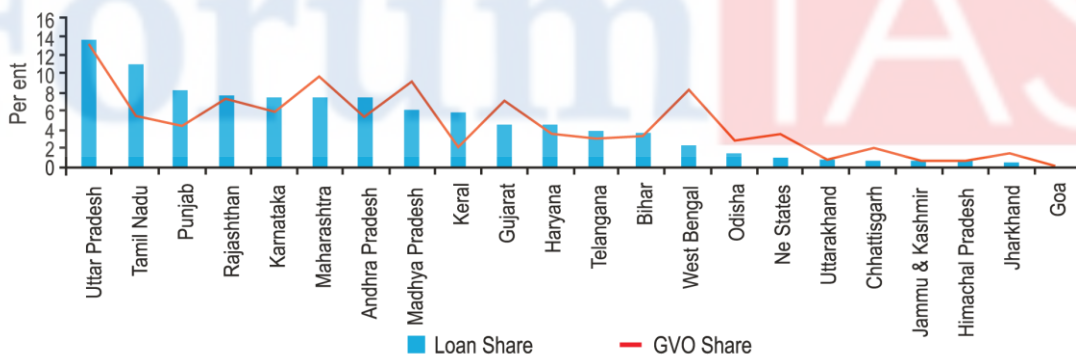
2.9 AGRI-FINANCE

Timely and adequate availability of finance is a prerequisite for the growth of any sector and agriculture is no exception.

RBI statistics on agriculture credit



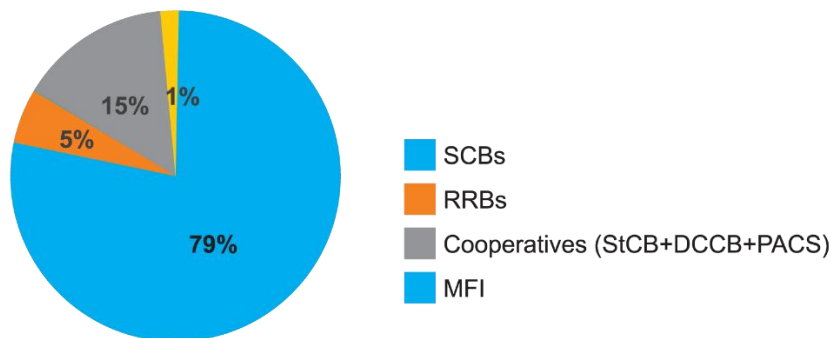
Direct Agriculture Credit as percentage of Agricultural GDP



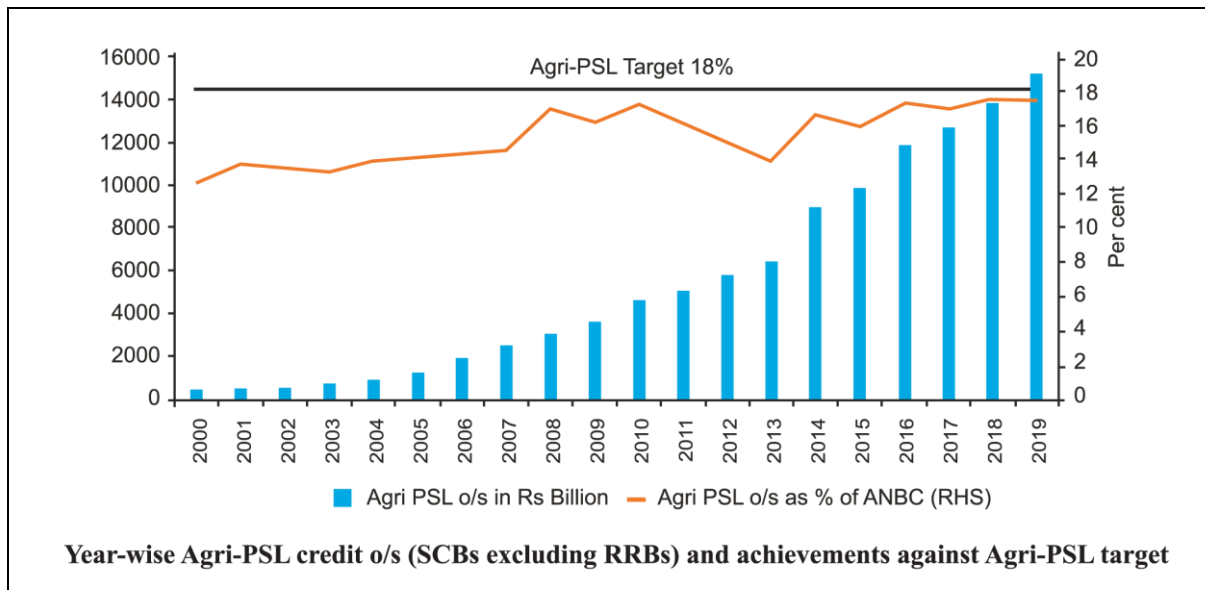
Source: RBI and MoSPI.

Methodology: Percentage share is based on average of 2014, 2015 and 2016 data for both loan and GVO

State-wise percentage share in overall crop loan o/s (SCBs and RRBs) and crop GVO



Agency-wise share in total agricultural credit outstanding as of March 31, 2017



Agri-finance is an essential component of agriculture as:

1. Finance is required to invest in agricultural inputs like seeds, fertilizers, machinery etc.
2. Agricultural finance is also needed for agricultural marketing, post-harvest storage and transport of produce, meeting the risks like damage due to pests, diseases and issues like low rainfall etc.
3. Institutional credit prevents farmers from falling into the clutches of money lenders who often lends at exorbitant interest rates and pushes farmers into debt traps.
4. Having money at disposal also provides a sense of psychological relief to the farmers as they are capable of meeting any unforeseen circumstances like crop losses, natural calamities etc.

To ensure timely availability of credit to the farmers, **government has taken the following steps:**

1. RBI's **Priority Sector Lending norms** stipulate 18% lending target for the agriculture sector.
2. **Nationalization of banks** in India has put them under government control and ensured that banks provide lending to the agricultural sector.
3. **Differential banks** like Regional Rural Banks (RRBs) provide lending to the agricultural sector at concessional rates.
4. Government has initiated **Kisan Credit Card (KCC) Scheme** and interest subvention scheme for providing cheap credit to the farmers.
5. NABARD started a pilot project **SHG-Bank Linkage Programme** in 1992 which also involves disbursement of agricultural credit.
6. **Joint Liability Groups (JLG)Scheme** was initiated by NABARD in 2006 to enhance credit flow to share-croppers/tenant farmers who do not have land rights.

Kisan Credit Card (KCC) Scheme

KCC was introduced in 1998 with the aim of providing adequate and timely credit with flexible and simplified procedure for agriculture related as well as consumption requirements of farmer households. The scheme comes with an ATM-enabled RuPay debit card and requires mandatory Aadhar seeding with bank accounts in order to avail the benefits.

The scheme is implemented by Commercial Banks, Regional Rural Banks (RRBs), Small Finance Banks (SFBs) and Cooperatives. KCC covers produce marketing loans, post-harvest expenses, working capital requirements for maintenance of farm assets and activities allied to agriculture, investment credit requirement for agriculture and allied activities.

Recently, KCC has been extended to farmers engaged in animal husbandry and fisheries. Also, the limit of collateral free agricultural loan has been raised from the earlier Rs. 1 lakh to Rs. 1.6 lakh and there would be zero processing fee of loans under KCC.

Interest Subvention Scheme

The scheme is being implemented by NABARD and RBI since 2006-07. It aims to provide short term crop loans up to Rs. 3 lakhs to farmers at an interest rate of 7% per annum. Public Sector banks (PSBs) and private banks offer interest subvention of 2%.

Farm loan waiver

The first nationwide farm loan waiver was implemented in 1990 by the Janata Party government led by then Prime Minister V.P. Singh and cost the government Rs. 10,000 crores. In February, the then Finance Minister of India announced Agricultural Debt Waiver and Debt Relief Scheme in India which included complete waiver of loans given to small and marginal farmers. Gradually, several states like U.P., Maharashtra etc. came up with loan waiver schemes.

There are several **arguments in favor of loan waivers** like:

1. Loan waiver will **increase the net wealth of farm households** pushing up the consumption.
2. **Bank balance sheets will improve** to the extent that non-performing farm loans are taken off their books. As a result, they might be able to provide additional financial resources to the private sector, leading to greater spending.
3. Loan waiver will help **reduce rural indebtedness**.
4. Farmers invest heavily in agriculture by taking loans and if crops fail, they are trapped in debt. This results in farmer suicides. Hence, loan waiver can **reduce farmer suicides** by relieving their debt burden.
5. Loan waiver will also **promote investment by the farmers** in the agricultural sector.

However, **several economists have expressed concern against loan waivers**:

1. Loan waiver **don't address the real reason** for farm stress like low productivity, fragmented landholdings, poor agricultural marketing infrastructure etc.
2. Waivers do not address all borrowers equally. It is observed **that rich farmers benefit more** from loan waivers as they are the ones who have access to formal bank credit. On the other hand, tenants are left out from the benefits of waiver.
3. Usually, only bank loans are waived, not **borrowings from informal sources**.
4. Loan waivers impact credit culture and **create a moral hazard**. Those farmers who can repay loans also stop doing so.
5. Access to more credit becomes difficult for farmers as **banks become wary of further lending**.
6. Overall development suffers as states are forced to cut spending elsewhere.

7. Loan waivers **create crowding out** impact as it results in higher borrowing by the states, which in turn could squeeze out private spending by firms.
8. Waivers create pressure for similar action in other states. Every state election now leads to a loan waiver announcement, thus making it a **populist measure**.

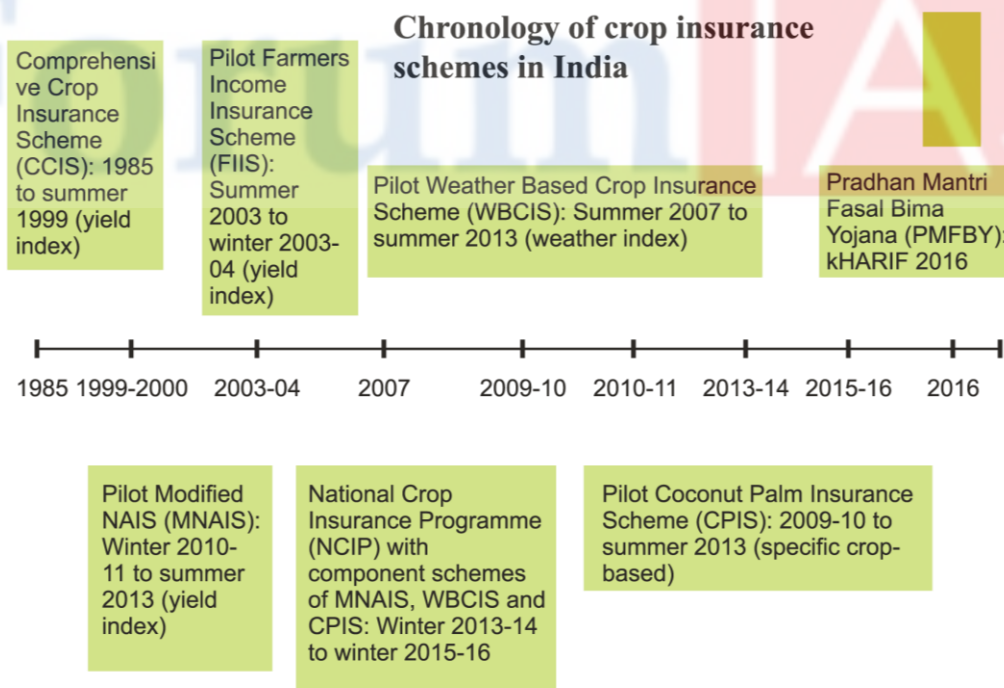
Key observations of CAG Audit regarding All-India Loan Waiver in 2008 include:

1. 13.5% of the eligible beneficiaries were excluded.
2. 8.5% cases where ineligible beneficiaries received relief.
3. 6% farmers not given benefits according to their entitlements.

Loan waiver offers short-term solution to our farm crisis. However, it will have negative macroeconomic consequences for India. Debt waiver therefore is neither sustainable nor feasible solution against agrarian distress. We need to work on finding long term solution to agricultural distress like building infrastructure, strengthening agriculture marketing etc.

2.10 AGRI-INSURANCE

India is having one of the largest agriculture dependent population in the world. Since it is a high-risk profession as farmers have to depend on rain and general weather conditions to grow their crops, government needs a prudent agricultural insurance policy to protect the farmers against such uncertainties.



National Agricultural Insurance Scheme (NAIS): Winter 1999-2000 to winter 2015-16 (yield index)

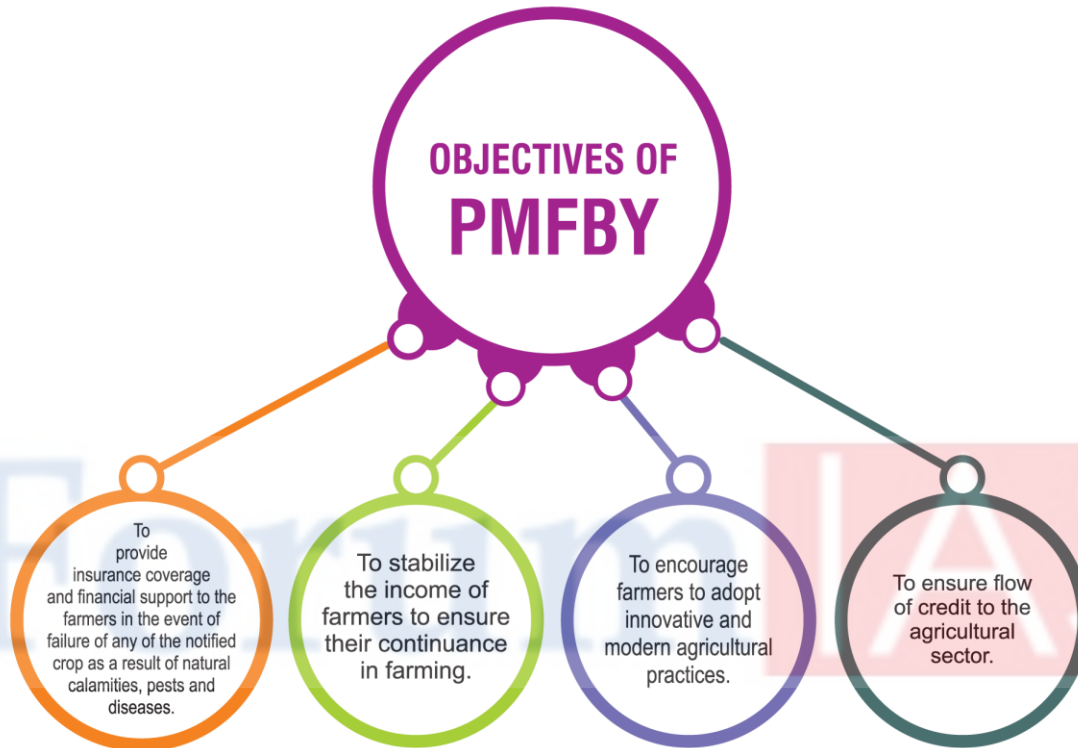
There are **two main reasons for the need of agricultural insurance** in India:

1. Farmers have traditionally relied on weather conditions to grow their crops. Hence, there is a need to protect them from agriculture variability which often results from uncertain weather conditions.

2. Agricultural crops also witness high price fluctuations, and this necessitates insurance against income failure.

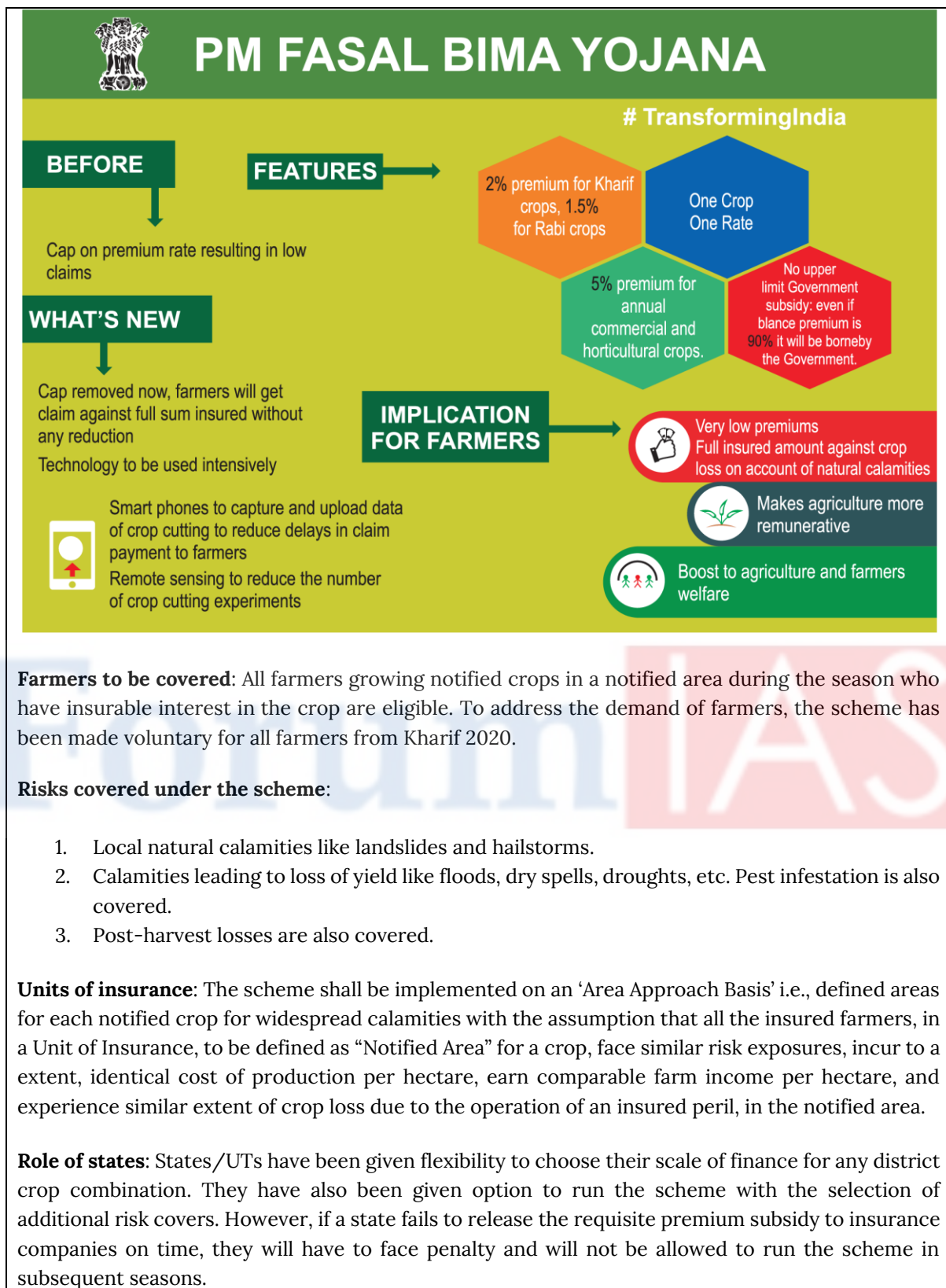
Pradhan Mantri Fasal Bima Yojana (PMFBY)

The PMFBY will replace the existing two schemes, **National Agricultural Insurance Scheme (NAIS) as well as the Modified NAIS**. The new scheme is in line with One Nation-One Scheme theme as it incorporates the best features of all previous schemes and at the same time, all previous shortcomings have been removed.



Highlights of the scheme:

1. There will be a uniform premium of 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%.
2. There is no upper limit on government subsidy.
3. Earlier, there was a provision of capping the premium rate which resulted in low claims being paid to farmers. This capping has now been removed and farmers will get claim against full sum insured without any reduction.
4. 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 delays in claim payments to farmers. Remote sensing will be used to reduce the number of crop-cutting experiments.
5. PMFBY is a replacement scheme of NAIS/MNAIS, there will be exemption from Service Tax liability of all the services involved in the implementation of the scheme.



While the government is taking steps to promote agricultural insurance, **the sector still faces many challenges** like:

1. **Penetration of agricultural insurance** is still low. A nation-wide crop insurance data by the National Institute of Securities Market or NISM (2014) shows that only 6.7% of the farmers are covered under crop insurance.

2. **Level of awareness** about crop insurance is very low.
3. The low usage indicates that farmers either do not find crop insurance useful or are denied access to insurance.
4. Insurance schemes like PMFBY have **failed in the North-Eastern States** due to insurance company's lack of interest in the region.
5. Other issues include delay in distribution of compensation, inadequacy of compensation compared to the costs and inadequate funds allocated to finance the insurance schemes.

By expanding agricultural insurance coverage, farmers can be encouraged to take risks and do investments without fear of any kind of loss. It is therefore imperative that we take steps to promote agri-insurance. Government should make conducive policies, private sector participation should be encouraged in this sector, companies should develop innovative insurance products to make them attractive for customers, Foreign Direct Investment (FDI) limits should be raised in the insurance sector from the present 49% etc. Further, usage of technologies like remote sensing needs to be fast-tracked to validate insurance claims of farmers and expediate compensation.

CHAPTER 3

AGRICULTURAL OUTPUTS

3.1 CROPS AND CROPPING PATTERNS

3.1.1 CROPPING PATTERNS

Cropping pattern refers to the yearly sequence and spatial arrangements of crops and fallow on a given area. The cropping pattern used on a farm along with its interactions with farm resources, other farm enterprises, and available technology determine their makeup.

1. **Multiple cropping:** Growing more than two crops in a piece of land in a year in an orderly succession.
2. **Double cropping:** Growing two crops in a piece of land in a year in sequence.
3. **Monoculture:** Repetitive growing of the same sole crop in the same land.
4. **Sequential cropping:** Growing two or more crops in a sequence on the same field in a year where succeeding crop is planted after the preceding crop has been harvested.
5. **Relay cropping:** Sowing of the next crop immediately before the harvest of the standing crops.
6. **Ratoon cropping:** Raising a crop with regrowth coming out of roots of the harvested crops.
7. **Intercropping:** Growing two or more crops simultaneously with distinct row arrangement on the same field at the same time.

Alley cropping is a variant of intercropping in which food crops are grown in alleys formed by hedge rows of trees or shrubs.

Relay intercropping refers to growing two sets of inter-crops one after another.

Intercropping offers **several advantages** like:

1. Suppression of weeds.
 2. Reduction in the incidence of pests and diseases.
 3. Improvement of soil health due to better use of growth resources like light, nutrients, and water.
 4. Yield stability is achieved and even if one crop fails due to unforeseen situations, another crop will yield and provide secure income. Also, intercropping gives higher yield and cropping intensity.
8. **Mixed cropping:** Growing two or more crops simultaneously intermingled without row arrangement. The main objective of mixed cropping is insurance against crop failure, and it is a type of subsistence farming.

3.1.2 FARMING SYSTEMS

Farming system is an approach for developing farm-household systems, built on the principles of productivity, profitability, stability and sustainability. The farming system approach emphasizes understanding of farm households, community interlinkages, reviews constraints, and assesses potentials.

1. **Sustainable agriculture:** It is a form of agriculture aimed at meeting the needs of present generation without compromising the needs of the future generation. It involves the use of manure, crop rotation and minimum tillage with minimum dependence on synthetic fertilizers. Sustainable agriculture prevents land degradation and soil erosion, replenishes nutrients and control weeds, pests and diseases.

Zero tillage

Tillage is the mechanical manipulation of soil with tools and implements for obtaining conditions ideal for seed germination, seed establishment and growth of crops.

Zero tillage is a type of tillage in which new crop is planted in the residues of the previous crop without any prior soil tillage or seed bed preparation. **Advantages of zero tillage include:**

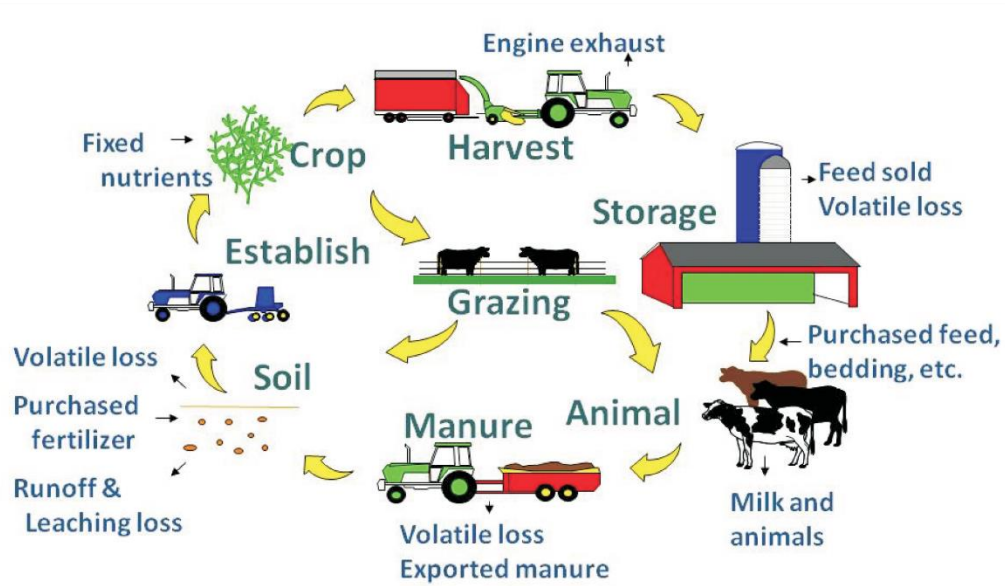
1. Organic matter content increases due to less mineralization.
2. Surface runoff is reduced due to presence of mulch.
3. Zero tilled soils are homogenous in nature with a greater number of earthworms.
4. Reduced or zero tillage can help in water conservation in agriculture.
5. Direct planting of paddy seeds in the wet soil is possible without the need for nursery of rice saplings.

Conservation agriculture

Conservation agriculture is a farming system that can prevent losses of arable land while regenerating degraded lands. Conservation agriculture involves the following:

1. Adopting minimum tillage.
2. Using crop residues to cover soil surface.
3. Adopting spatial and temporal crop sequencing/crop rotation.

2. **Integrated farming system:** Integration of farm enterprises such as cropping systems, animal husbandry, fisheries, forestry, etc. for optimal utilization of resources bringing prosperity to the farmer is known as integrated farming system.



Integrated Farming System Model

Benefits of integrated farming system include:

1. Employment creation.
 2. Increased productivity.
 3. Better utilization of land, labor, time, and available manures in the farm.
 4. Guarantees steady income other than income from regular cropping. It also ensures risk coverage due to subsidiary allocation in the event of unexpected crop failures.
3. **Permaculture:** Permaculture is an approach to land management and philosophy that adopts arrangements observed in flourishing natural ecosystems. It includes a set of design principles derived using whole systems thinking. Emphasis is placed on multi-use plants, cultural practices such as sheet mulching and trellising, and the integration of animals to recycle nutrients and graze weeds.
- Mulch** is simply a protective layer of material that is spread on top of the soil. Mulches can either be organic- such as grass clippings, straw, bark chips and similar materials- or inorganic- such as stones, brick chips, and plastic. Reasons for applying mulch include conservation of soil moisture, improving fertility and health of the soil, reducing weed growth and enhancing the visual of appeal of the area.
4. **Wetland farming:** Practice of growing crops in soils flooded by water for most part of the year.
 5. **Garden land farming:** Growing crops with supplemental irrigation by lifting water from underground sources.
 6. **Dry land farming:** Practice of crop production entirely depending upon rainfall and the moisture conserved in the soil.
 7. **Rain fed farming:** Crop production in areas where rainfall is more than 750 mm.

8. **Mixed farming:** System of farming on a piece of land which includes crop production, raising livestock, poultry, fisheries, bee keeping, etc. to sustain and satisfy as many needs of the farmer as possible.

Mixed farming offers several **advantages** like:

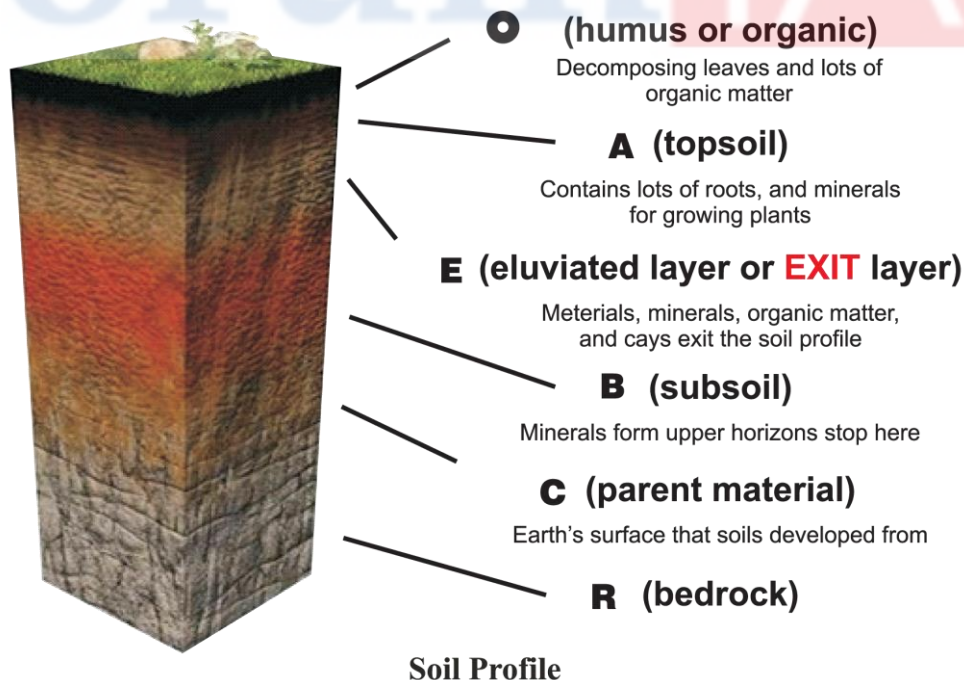
1. It offers highest return on farm business.
2. It provides work throughout the year.
3. It offers efficient utilization land, labor, equipment and other resources.
4. The crop by-products such as straw, fodder, etc. is used for feeding of livestock and in return they provide milk.
5. Manures from livestock is used to maintain soil fertility.

3.1.3 CROPS

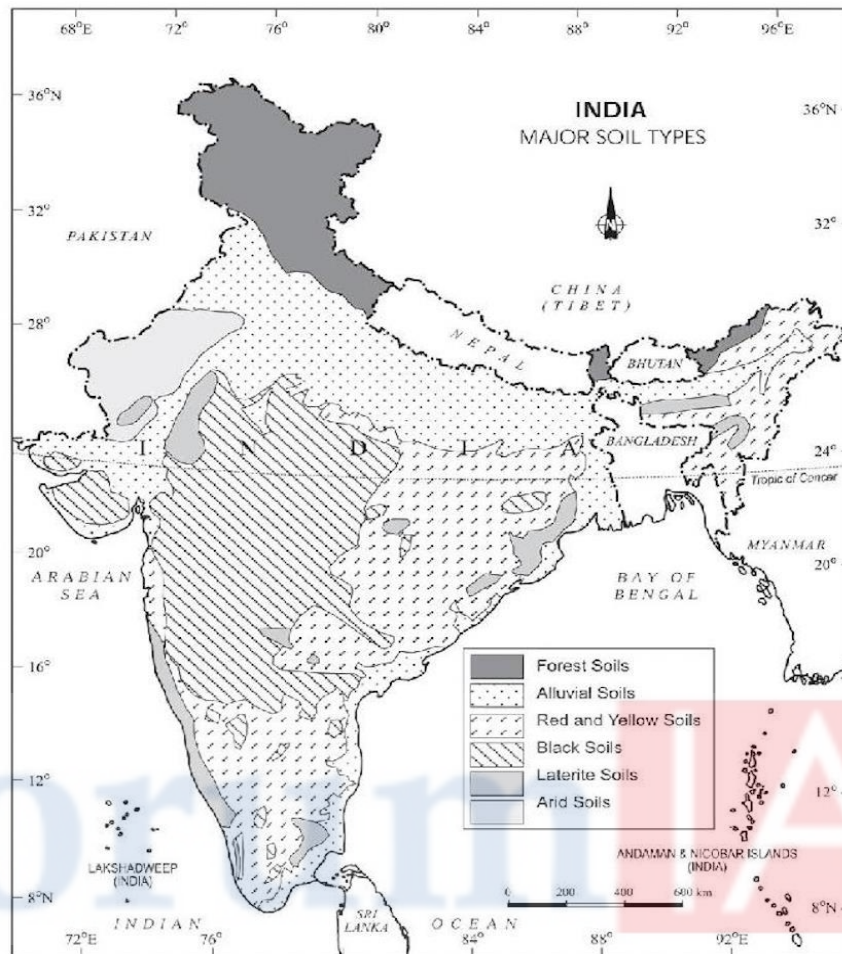
A crop is a plant or animal product that is grown and harvested for profit or subsistence. Crops refer either to the harvested parts or the harvest in a more refined state. Most crops are cultivated in agriculture or aquaculture and may include macroscopic fungus or alga.

Agricultural soils

Types of crop that can be grown and its yield largely depends upon the soil profile of the region. Soil is the mixture of rock debris and organic materials which develop on the earth's surface. The major factors affecting the soil formation are relief, parent material, climate, vegetation and other life-forms and time. Components of the soil are mineral particles, humus, water and air.



Types of soils in India are as follows:



Major soil types of India

1. **Alluvial soils:** Alluvial soils are widespread in the northern plains and the river valleys. These soil cover about 40% of the total area of the country. They are depositional soils transported and deposited by rivers and streams.

Alluvial soils are rich in potash but poor in phosphorus. There are two different types of alluvial soils- Khadar (new alluvium) and Bhangar (older alluvium). Both the Khadar and Bhangar soils contain calcareous concretions (kankars).

2. **Black soils:** Black soil covers most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu. These soils are also known as the 'Regur Soil' or the 'Black Cotton Soil'.

The black soils are generally clayey, deep and impermeable. They swell and become sticky when wet and shrink when dried. So, during the dry season, these soils develop wide cracks. Thus, there occurs a kind of 'self-ploughing'.

Chemically, black soils are rich in lime, iron, magnesia, and alumina. They also contain potash. But they lack in phosphorus, nitrogen and organic matter.

3. **Red and Yellow soils:** Red soil develops on crystalline igneous rocks in areas of low rainfall in the eastern and southern parts of the Deccan plateau. Along the piedmont zone of the Western ghats, long stretch of area is occupied by red loamy soil. Yellow and red soils are also found in parts of Orissa and Chhattisgarh and in the southern parts of the middle Ganga plain.

The soil develops a reddish colour due to a wide diffusion of iron in crystalline and metamorphic rocks. It looks yellow when it occurs in a hydrated form. They are generally poor in nitrogen, phosphorus and humus.

4. **Laterite soils:** Laterite soils develop in areas with high temperature and high rainfall. These are a result of intense leaching due to tropical rains. With rain, lime and silica are leached away, and soils rich in iron oxide and aluminum compound are left behind. Humus content of the soil is removed fast by bacteria that thrives well in high temperature. These soils are poor in organic matter, nitrogen, phosphate and calcium while iron oxide and potash are in excess. Hence, laterites are not suitable for cultivation.

Red laterite soils in Tamil Nadu, Andhra Pradesh and Kerala are more suitable for tree crops like cashew. Laterite soils are widely cut as bricks for use in house construction.

5. **Arid soils:** They are generally sandy in structure and saline in nature. Due to the dry climate, high temperature and accelerated evaporation, they lack moisture and humus. Nitrogen is insufficient and phosphorus content is normal.

6. **Saline soils:** Saline soils contain a large proportion of sodium, potassium and magnesium and thus, they are infertile. They occur in arid and semi-arid regions, and in water-logged and swampy areas. Saline soils are more widespread in western Gujarat, deltas of the eastern coast and in the Sundarbans areas of West Bengal.

Seawater intrusions in the deltas promote the occurrence of saline soils. In areas of intensive cultivation with excessive use of irrigation, especially in areas of green revolution, fertile soils are becoming saline. Excessive irrigation promotes capillary action, which results in the deposition of salt on the top layer of the soil.

In such areas with saline soils, farmers are advised to add gypsum to solve the problem of salinity in the soil. Calcium in gypsum acts as a flocculating agent and helps improve the infiltration of soil structure, thus helps the washout of sodium salt and reduce salt indirectly.

7. **Peaty soils:** They are found in areas of heavy rainfall and high humidity, where there is a good growth of vegetation. Thus, large quantity of dead organic matter accumulates in these areas, and thus gives a rich humus and organic content to the soil.

Soil degradation and conservation

Soil degradation in India is on the rise due to deforestation, overuse of synthetic fertilizers, etc. Soil erosion has removed the fertile top layers of the soil, which is rich in organic content. Reduced organic content lowers water retention capacity, thereby leading to loss in productivity.

Hence, soil conservation has become paramount considering the importance of agriculture in sustaining our socio-economic development. Over-grazing and shifting cultivation in many parts of

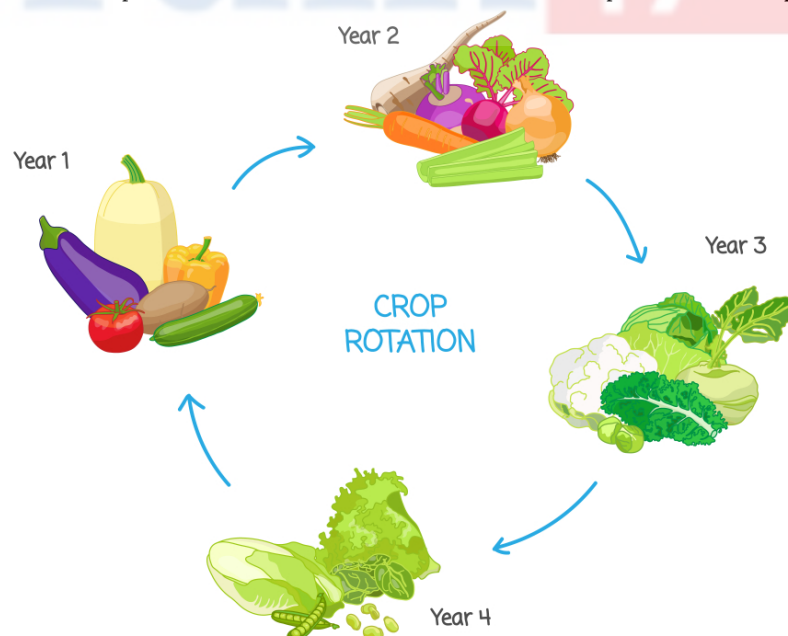
India needs to be regulated. Contour bunding, contour terracing, regulated forestry, controlled grazing, cover cropping, mixed farming, integrated nutrient management, crop rotation and wind breaks are some of the remedial measures to reduce soil erosion.

1. **Terrace farming** is the practice of cutting flat areas out of a hilly or mountainous landscape in order to grow crops.



Terrace farming

2. **Contour bunding** is one of the simple methods of soil and water conservation. This technique is used at places where land is sloppy. Due to slope, soil and nutrients erode fast which makes agriculture on this land very uneconomical. To adopt this technique, contours are marked and then bunds are taken along the contours.
3. **Crop rotation** means planting different crops sequentially on the same plot of land to improve soil health, optimize nutrients in the soil, and combat pest and weed pressure.



4. A **windbreak** is a planting usually made up of one or more rows of trees or shrubs planted in such a manner as to provide shelter from the wind and to protect soil from erosion.



Windbreak

5. **Integrated Nutrient Management (INM)** is a judicious combination of organic, inorganic and biofertilizers which replenishes the soil nutrients which are then removed by the crops. It leads to higher crop productivity without diminishing soil fertility.

3.1.3.1 CLASSIFICATION OF CROPS

Classification based on climate

1. **Tropical crops:** Crops grown in warm and hot climate. E.g., rice, sugarcane and jowar.
2. **Temperate crops:** Crops grown in cool climate. E.g., wheat, gram, oats and potato.

Classification on the basis of growing season

1. **Kharif crops:** These crops are grown in monsoon months from Jun to Oct-Nov and require warm and wet weather at major period of crop growth. Further, they also require short day length for flowering. E.g., cotton, rice, jowar and bajra.
2. **Rabi crops:** These crops are grown in winter season from October to March and require cold and dry weather. Further, they also require longer day length for flowering. E.g., wheat, gram and sunflower.
3. **Zaid crops:** These crops are grown in summer months from March to June. They require warm dry weather and longer day length for flowering. E.g., watermelon, pumpkin, groundnuts and gourds.

Agronomic classification of crops

1. **Cereals:** A cereal is any grass cultivated for the edible components of its grain. E.g., rice, wheat, maize, barley and oats.

2. **Millets:** Millets are a group of highly variable small-seeded grasses, widely grown around the world as cereal crops or grains for fodder and human food. Millets are important crops in the semiarid tropics of Asia and Africa, with 97% of millet production in developing countries.

In India, millets are considered staple food of poor people and are grown in less area or less important area whose productivity and economics are also less. E.g., sorghum/jowar, bajra and ragi.
3. **Pulses or Grain Legumes:** Pulses are major sources of proteins in Indian diet and provide most of the essential amino acids to a certain degree. It is cultivated to enrich the soil, to utilize the residual moisture and to give revenue in a shorter period. E.g., red gram, black gram, green gram, peas and soyabean. **Cowpea, green gram and pigeon pea are also used as fodder and green manure.**
4. **Oil Seed crops:** These crops are cultivated for the production of oil, either for industrial or medicinal purpose. E.g., groundnut, sunflower, mustard and castor.
5. **Sugar crops:** Sugar stem is used for jaggery or sugar. By-products like molasses, bagasse and pressmud are obtained. Molasses is used for alcohol and yeast formation, bagasse is used for paper making and fuel, and pressmud is used for soil amendment.
6. **Starch crops:** Starch is a polymeric carbohydrate consisting of numerous glucose units joined by glycosidic bonds. E.g., potato and tapioca/cassava.
7. **Fibre crops:** These crops are plants that are deliberately grown for the production of fibre for textile (clothes), cordage (e.g., ropes), and filling (e.g., stuffing mattresses). Cotton, jute, kenaf, industrial hemp, sun hemp, and flax are some well-known fibres.
8. **Forage crops:** These crops are grown specifically to be grazed by livestock or conserved as hay or silage. E.g., grasses or other plants, such as clover or alfalfa, are cut and dried for fodder.
9. **Plantation crops:** Plantation crops are those which are cultivated on extensive scale like tea, coffee and rubber.

Classification based on duration of crops

1. **Seasonal crops:** A crop which completes its life cycle in one season. E.g., rice, jowar, wheat etc.
2. **Two seasonal crops:** A crop which takes two seasons to complete its life cycle. E.g., cotton, turmeric and ginger.
3. **Annual crops:** Crops which completes its life cycle in one year. E.g., sugarcane.
4. **Biennial crops:** Crops which takes two year to complete its life cycle. E.g., banana and papaya.
5. **Perennial crops:** Crops which live for several years. E.g., fruit crops, mango, guava etc.

Classification based on water

1. **Rainfed crops:** Rainwater availability determines cultivation of crops. E.g., jowar, bajra, groundnut, sesamum, and pearl millet.
2. **Irrigated crops:** Crops are cultivated with the help of irrigated water. E.g., sugarcane.

Classification on the basis of root system

1. **Tap root system:** Tap root is one of the two essential root systems where the primary root gives out branches of secondary and tertiary roots growing downwards as the primary root tapers towards the end. E.g., tur, grape and cotton.
2. **Fiber rooted:** The fibrous root is the other type of root systems where the root develops from the stem in the form of thin and moderately branching roots without any primary root.. E.g., wheat, rice and cereals.

Classification on the basis of economic importance

1. **Cash crops:** Crop grown for earning money. E.g., sugarcane, cotton.
2. **Food crops:** Crops grown for feeding the population and as fodder for cattle. E.g., jowar, wheat and rice.

Classification on the basis of number of cotyledons

1. **Monocot:** Monocotyledons, also referred to as monocots, are flowering plants bearing seeds with a single cotyledon or embryonic leaf. E.g., cereals and millets.
2. **Dicot:** Dicots are flowering plants bearing seeds with two cotyledons or embryonic leaves like legumes and pulses and almost all trees.

Classification based on the length of photoperiod required for floral initiation

1. **Short-day plants:** Flower initiation takes place when days are short. E.g., rice, jowar, gram, etc.
2. **Long-day plants:** They require long day for flower initiation. E.g., wheat and barley.
3. **Day neutral plants:** Flower initiation for such plants is not affected by the length of day. E.g., cotton, sunflower, etc.

3.1.3.2 MAJOR CROPS

Due to diverse climatic and edaphic conditions, India is blessed with a diversity of crops grown in different regions.

Group/Commodity	Area (Million ha)	Percentage change in area over 2015-16	Production (Million tonnes)	Percentage change in production over 2015-16	Yield (kg/ha)	Percentage change in yield over 2015-16
Foodgrains*	128.0	3.9	275.68	9.6	2153	5.5
Rice	43.2	-0.7	110.15	3.5	2550	6.3
Wheat	30.6	0.6	98.38	6.6	3216	6.0
JowM	5.1	-15.4	4.57	7.9	889	27.5
Maize	9.9	12.0	26.26	16.4	2664	3.9
Bajra	7.5	4.8	9.80	21.5	1311	15.9
Pulses	29.5	18.3	22.95	40.4	779	18.7
Grain	9.6	14.1	9.33	32.1	973	15.8
Tur	5.4	36.3	4.78	86.6	885	36.9
Oilseeds	26.1	0.5	32.10	27.1	1225	26.5
Groundnut	5.3	15.6	7.56	12.4	1424	-2.8
Rapeseed and Mustard	6.0	4.8	7.98	17.4	1324	12.0
Cotton"	10.8	-11.8	33.09	10.3	519	25.0
Sugarcane	4.4	-10.9	306.72	-12.0	70#	-1.2

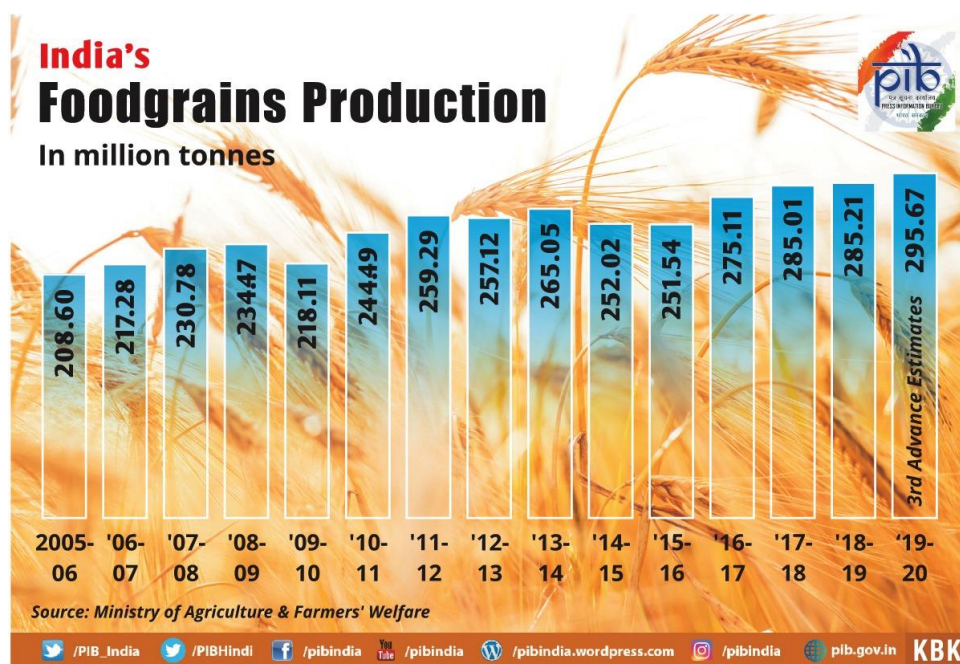
Source: Directorate of Economics & Statistics, Department of Agriculture, Cooperation and Farmers' Welfare.
 Note: * : Fourth Advance Estimates; " : tonnes/ha, *:Includes cereals and pulses; ^b : Million Bales of 170 kg each.

Area, Production and Yield of Major Crops

1. Foodgrains

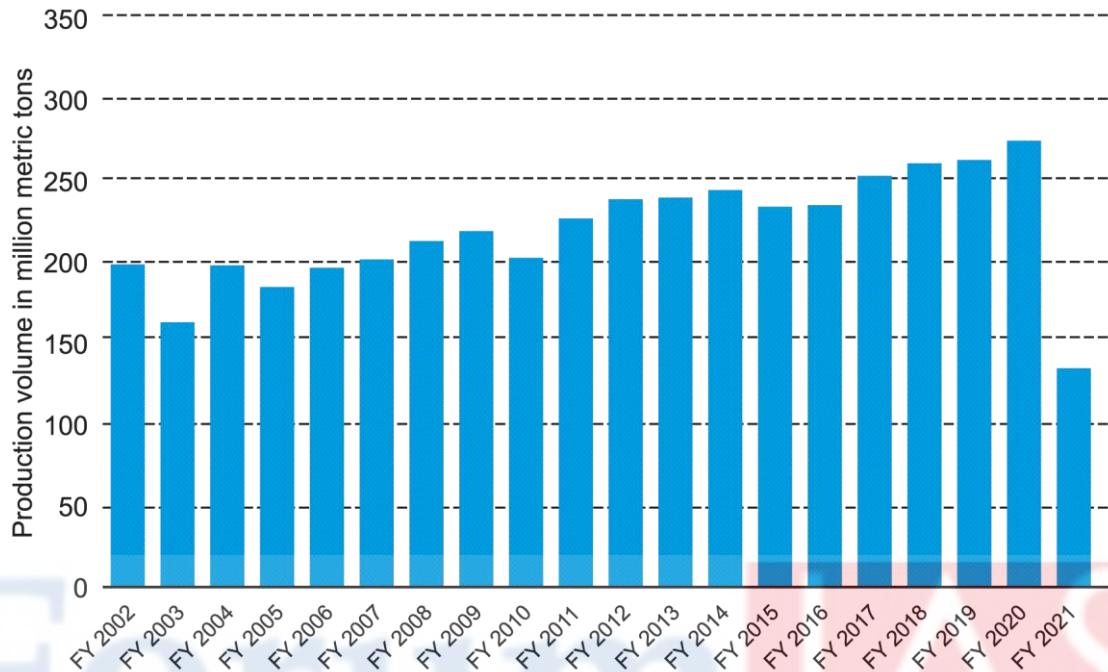
In the 2019-20 crop year, India's foodgrain production output (comprising wheat, rice, pulses and coarse cereals) stood at a record high 297.5 million tonnes (MT).

Also, as per the Agriculture Ministry, foodgrain production is expected to rise 2% in 2020-21 crop-year to an all-time high of 303.34 MT on better output of rice, wheat pulses and coarse cereals amid good monsoons last year.



Cereals

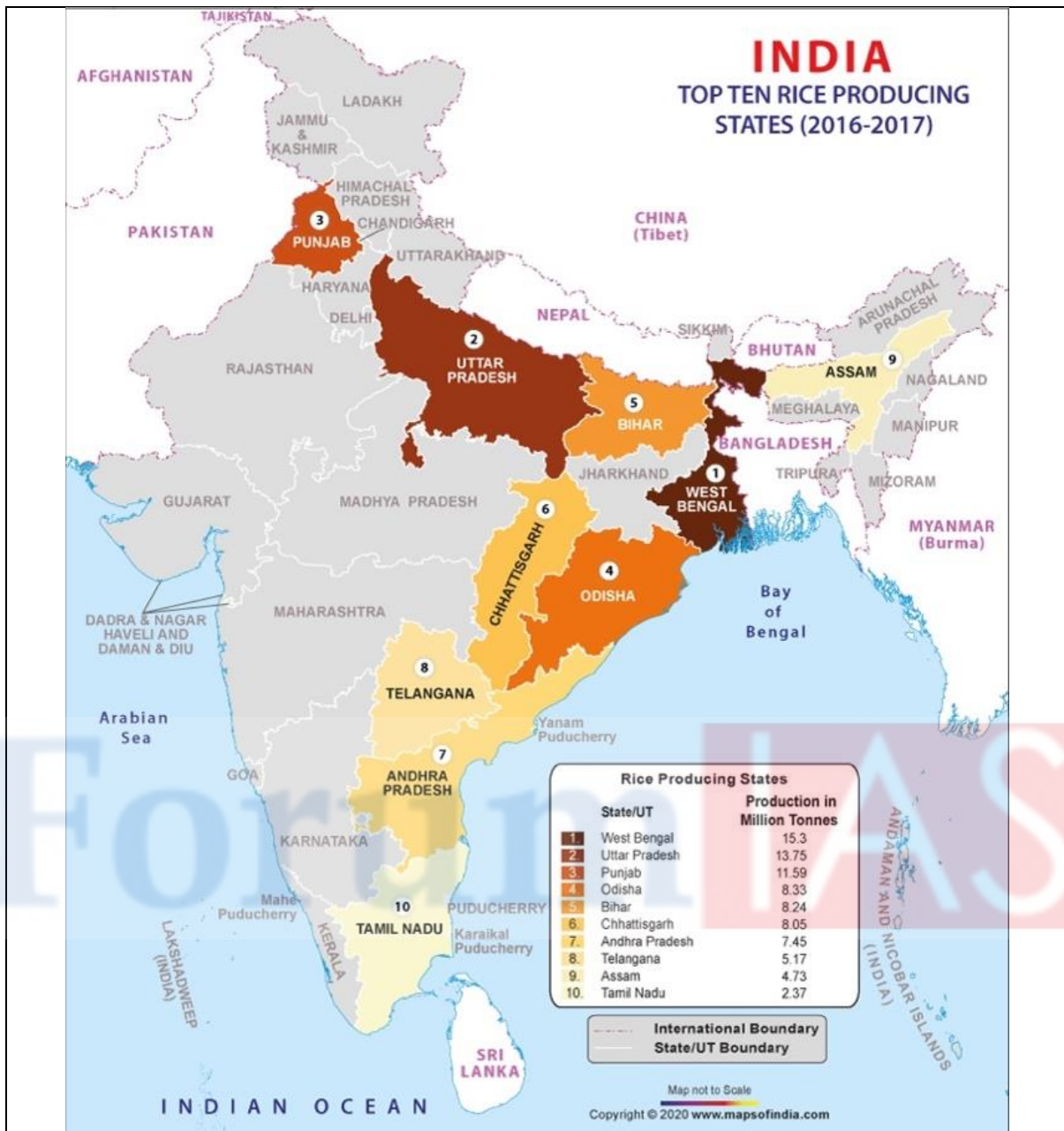
More than 135 million metric tonnes of cereals were estimated to be produced in India at the end of financial year 2021. These cereals include rice, wheat, barley, millets, and ragi among others. The cereals occupy about 54% of the total cropped area in India. The country produces about 11% cereals of the world and ranks third in production after China and U.S.A.



Production volume of cereals in India from financial year 2002 to 2019, with estimates for 2020 and 2021

Source- Statista Research Department

1. **Rice:** Rice is a staple food for the overwhelming majority of population in India. In India rice is grown in 43.86 million ha, the production level is 104.80 MT, and the productivity is about 2390 kg/ha (Agricultural Statistics at a glance-2015).



Top ten rice producing states in India

India ranks second in the world in terms of volume of rice produced but its productivity is low compared to the productivity levels of any countries in the world. Also, about 90% of the cultivated land belongs to Marginal, Small and Medium farmers which is another constraint in increasing the productivity of rice in the country. Hence, there is ample scope to increase the productivity of rice in the country.

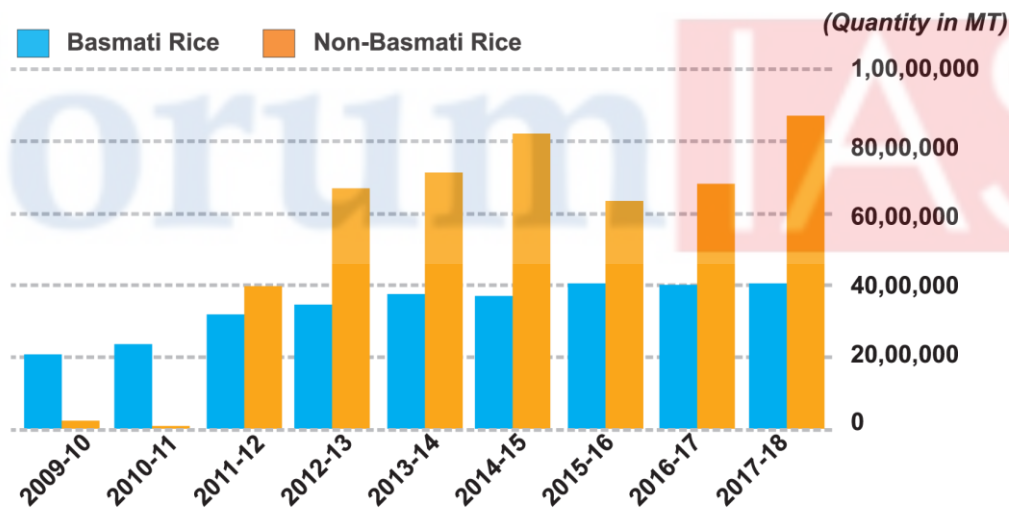
Area: million ha, Production: million tones and yield in kg/ha

Country	Area	Production	Productivity	Production %
1. China	30.58	205.21	6710	27.70
2. India	43.86	104.80	2390	21.81
3. Indonesia	13.84	71.29	5152	9.62
4. Bangladesh	11.78	51.50	4376	6.95
5. Vietnam	7.90	44.04	5573	5.94
Total for World	107.96	476.84	4417	

Source :Agricultural statistics at a glance 2015

Major rice growing countries in the world

In terms of export, India is the leading exporter of rice in the world. During 2015-16, the country has exported globally about 40.45 lakh MT of Basmati rice and 63.66 lakh MT non-basmati rice. Also, India exports rice mostly to the Arab region (Saudi Arabia, Iran, UAE, Iran and Kuwait). Recently, government set up **Rice Export Promotion Forum (REPF)** under the aegis of APEDA to identify, document particulars and reach out to stakeholders across the entire production/supply chain of export of rice for increasing these exports significantly to the global market.



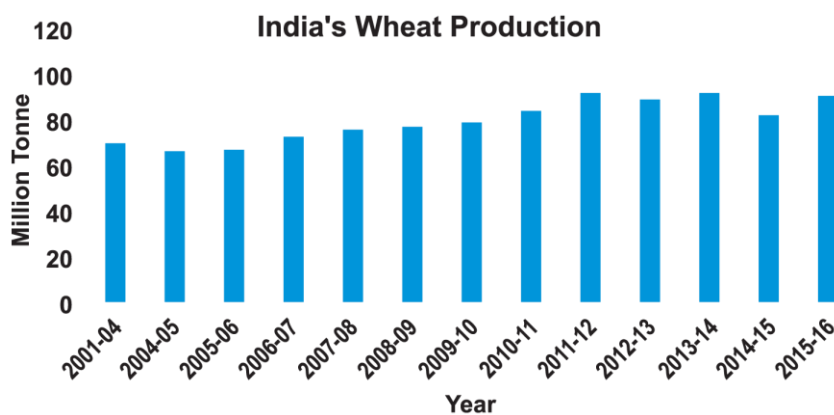
Value of rice exports

- Wheat:** Wheat is the second most important cereal crop in India after rice. India produces about 12% of the total wheat production of the world and is the second largest producer after China. It is primarily a crop of temperate zone. Hence, its cultivation in India is done during winter i.e., rabi season.



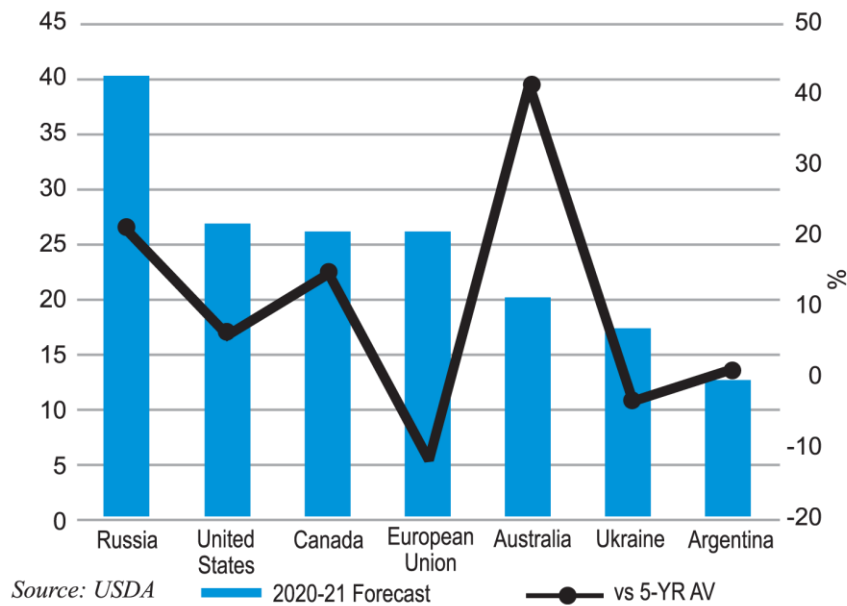
Top ten wheat producing states in India

The total area under the crop is about 29.8 million hectares in the country. The production of wheat in the country has significantly increased from 75.81 million MT in 2006-07 to an all-time record high of 94.88 million MT in 2011-12.

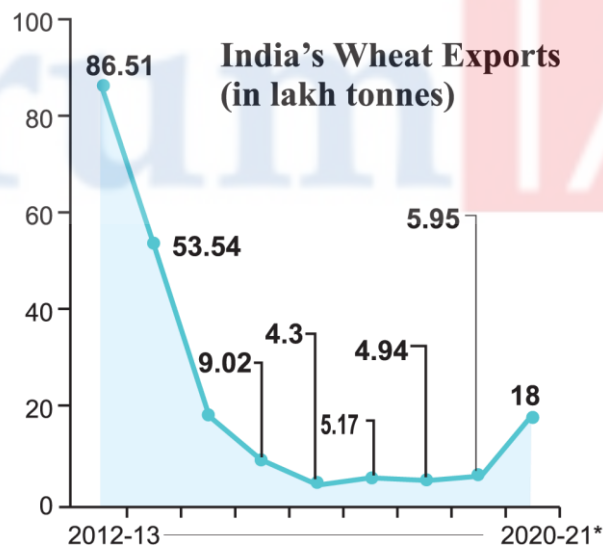


India's wheat production volume

In terms of export, India ranks much behind countries like Russia and U.S.A. as most of its production is consumed internally.



Top 2020-21 wheat exporters



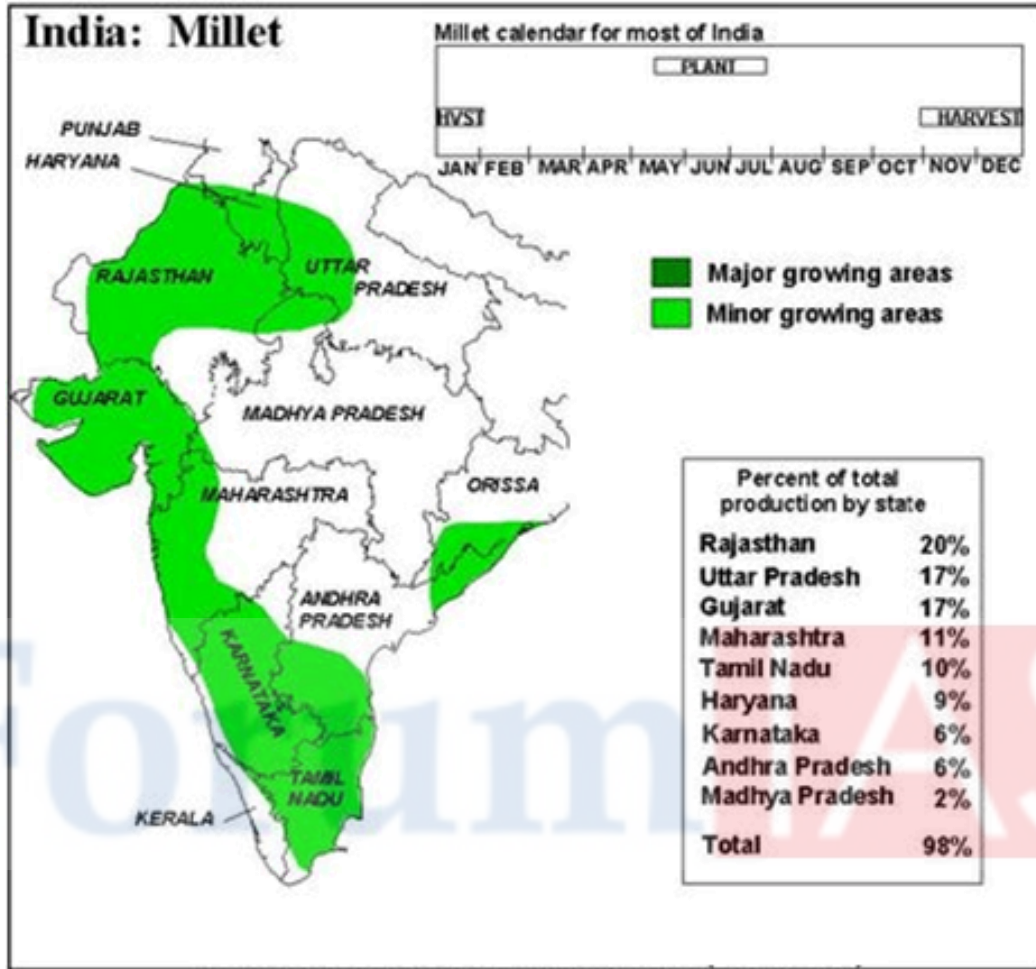
*Projected, Source: USDA

Millets (Nutri-Cereals)

Millet refers to small-seeded grasses that are often termed nutri-cereals or dryland-cereals. It includes jowar, bajra and ragi. Millets can be grown in inferior soils as they are less sensitive to soil deficiencies. Top millet producing states in the country are Rajasthan, Karnataka, Maharashtra, Madhya Pradesh and Uttar Pradesh in the same order.

Millets are known for their high nutritional value. For e.g., ragi is rich in iron, calcium, and roughage. In order to encourage millet production, Government started the '**Initiative for Nutritional Security**

through Intensive Millets Promotion'. The initiative aims to demonstrate the improved production and post-harvest technologies, and to demonstrate value addition techniques, in an integrated manner, with cluster approach. Also, considering the fact that millet cultivation is done mainly by the poor and marginal farmers, they have a larger stake in this scheme.



Millet distribution in India

- Jowar:** The coarse cereals together occupy 16.50% of the total cropped area in the country. Among these, jowar and sorghum alone accounts for about 5.3% of the total cropped area.

It is the main food in semi-arid areas of central and southern India. Maharashtra alone produces more than half of the total jowar production in the country. Other leading producer states of jowar are Karnataka, Madhya Pradesh, Andhra Pradesh and Telangana.

It is sown in both kharif and rabi seasons in southern states but it is a kharif crop in northern India where it is mostly grown as a fodder crop.

- Bajra:** Bajra is sown in hot and dry climatic conditions in north-western and western parts of the country. It is a hardy crop which resists frequent dry spells and drought in the country. This coarse cereal occupies about 5.2% of the total cropped area in the country.

Rajasthan is the leading producer of Bajra in the country followed by Uttar Pradesh, Gujarat, Madhya Pradesh and Haryana.

Maize

Maize is a food as well as fodder crop sown under semi-arid climatic conditions and over inferior soils. This crop occupies only about 3.6% of the total cropped area.

It can be used for the production of starch. Maize has oil extracts that can be converted to ethanol or biodiesel. Alcoholic beverages can also be produced using maize.

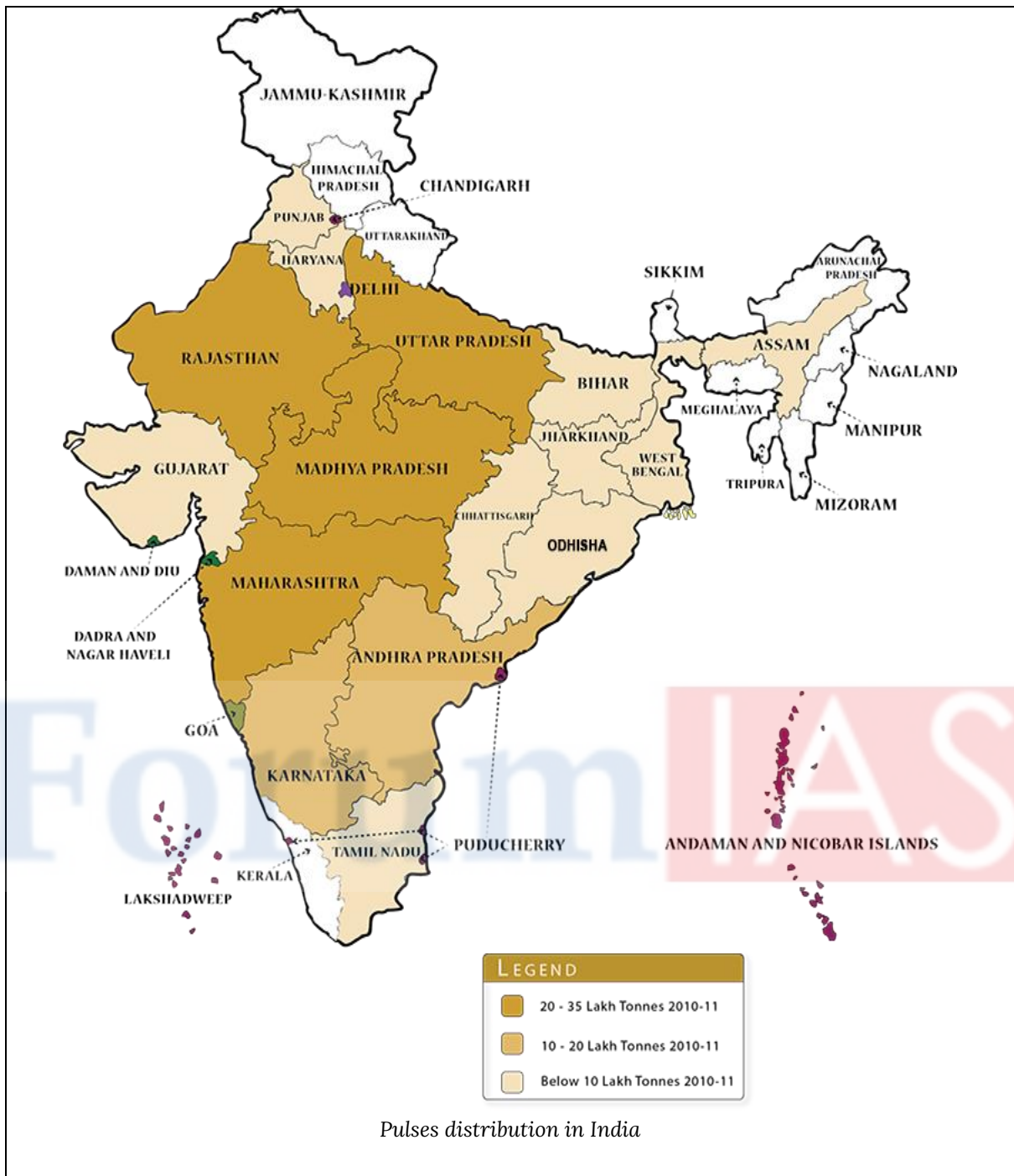
The U.S.A is the largest producer of maize in the world and contributes nearly 35% of the total production in the world. In India, maize is the third most important food crop after rice and wheat and its production is likely to be 2.23 MT (2012-13) mainly during kharif season.

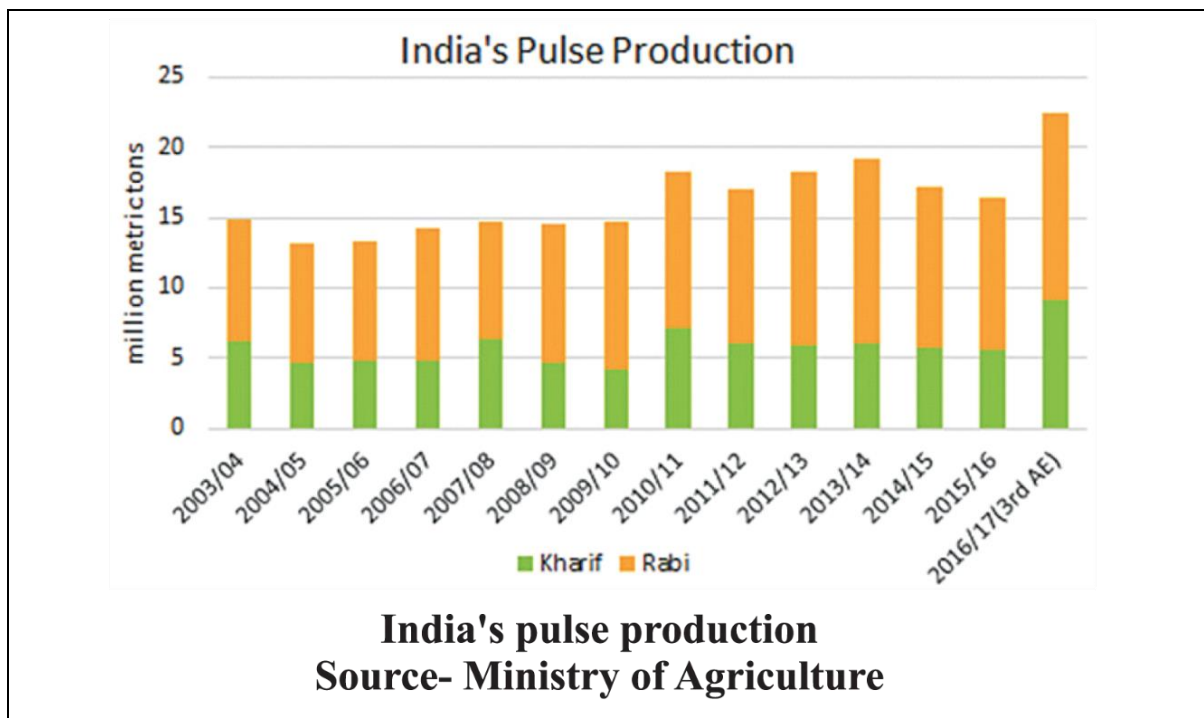
The prominent maize growing states are Andhra Pradesh (20.9%), Karnataka (16.5%), Rajasthan (9.9%), Maharashtra (9.1%), and Bihar (8.9%).

Pulses

Pulses are legume crops which increase the natural fertility of soils through nitrogen fixation. Further, they are also rich sources of protein. Gram and tur are the main pulses cultivated in India. India is the leading producer of pulses and accounts for about one-fifth of total production of pulses in the world. **Madhya Pradesh** is the leading producer of pulses followed by Rajasthan, Maharashtra, Uttar Pradesh, and Karnataka.

1. **Gram:** Gram is a rainfed crop cultivated during rabi season in central, western, and northwestern parts of the country. At present, gram covers only about 2.8% of the total cropped area in the country.
2. **Black Gram (Urad):** Urad can be cultivated as both kharif and rabi crops.
3. **Green Gram (Moong):** Moong can be cultivated as both kharif and rabi crops. However, its production is much lower than gram (as per 3rd advanced estimates 2019-20, gram production was 10.90 million tonnes compared to 2.34 million tonnes of moong).
4. **Tur:** Tur is the second most important pulse crop in the country. It is also known as red gram or pigeon pea. This crop occupies only about 2% of total cropped area of India and Maharashtra alone contributes about one-third of the total production of tur.





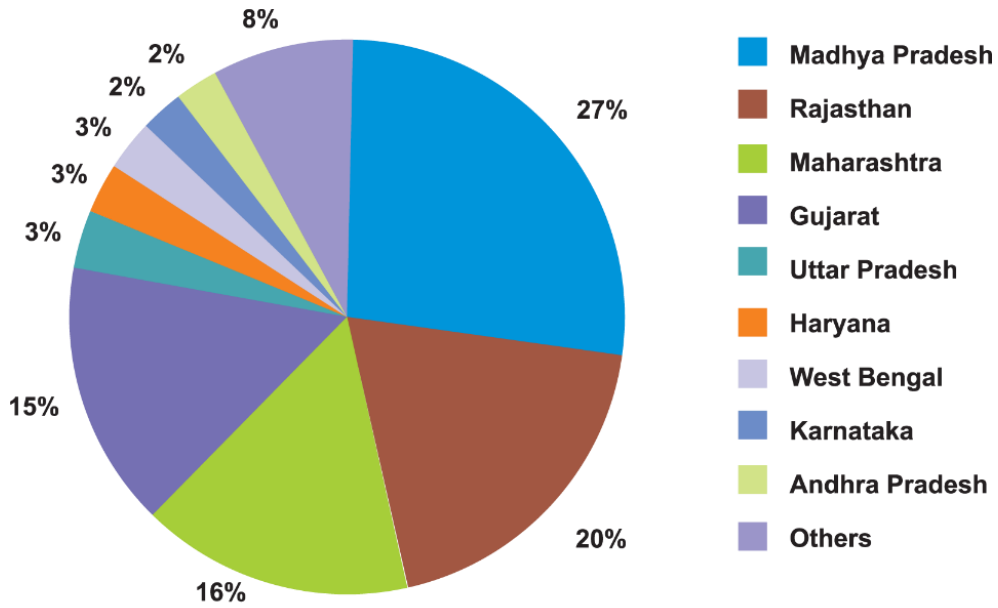
While food grains production is expected to touch record high, **there are certain challenges associated with it** like:

1. **Uncertain monsoons** affect the foodgrain production.
2. **Absence of storage infrastructure** for food grains often leads to wastage.
3. **Productivity** of food grains per hectare is very low compared to other countries. For e.g., our rice productivity is about half than that of China.
4. Production of food grains like rice has led to over-exploitation of groundwater, leading to an **environmental crisis**.
5. **Minimum Support Price (MSP)** is not applicable to all foodgrains, thus denying farmers their share.
6. There is a **lack of awareness** amongst farmers regarding government schemes related to foodgrain sector.
7. **Insufficient marketing infrastructure** denies farmers the right price for their produce.
8. Since 1991, area under food crops have increased while area under non-food crops have remained constant. As a result, farmers are trapped in a "**low risk-low income**" cultivation because food crops command less price in the market compared to non-food crops.

Hence, government need to encourage food grain production by taking steps like introducing hybrid varieties, developing storage infrastructure, strengthening marketing infrastructure like e-NAM (electronic National Agriculture Market), increasing Minimum Support Price (MSP) on food grains, shifting from water intensive crops like rice cultivation to drought resistant crops like millets in areas facing water crisis, etc.

2. Oilseeds

The oilseeds are produced for extracting edible oils. Drylands of Malwa plateau, Marathwada, Gujarat, Rajasthan, Telangana, Rayalaseema region of Andhra Pradesh and Karnataka plateau are oilseeds growing regions of India.

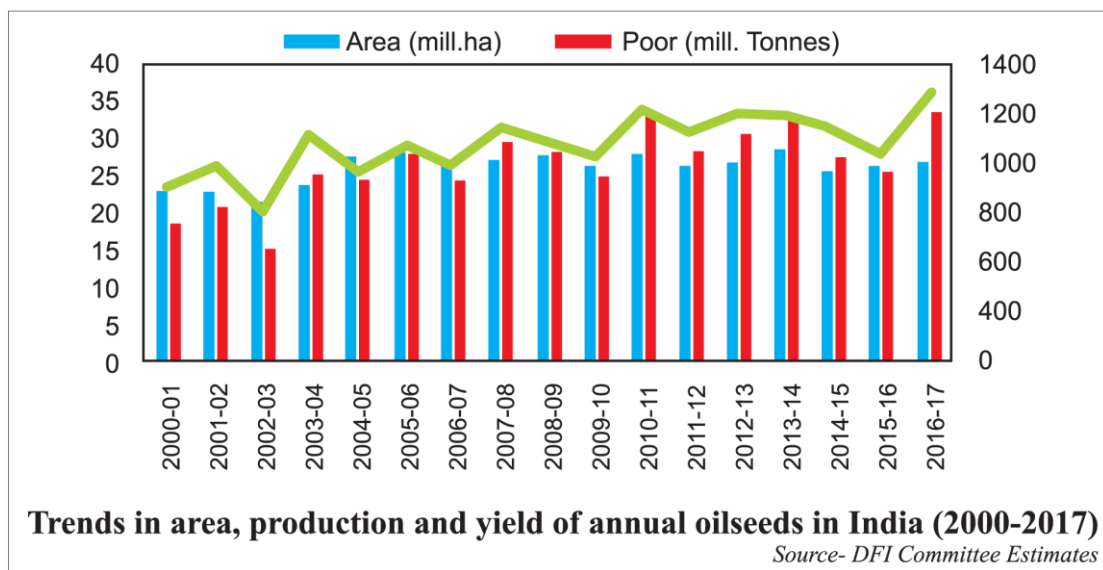


% contribution in production

These crops together occupy about 14% of the total cropped area in the country, 3% of the Gross National Product and 10% value of all agricultural commodities. Groundnut, rapeseed and mustard, soyabean and sunflower are the main oilseed crops grown in India.

1. **Groundnut:** It is largely a rainfed kharif crop of the drylands. But in southern India, it is cultivated during rabi season as well. **Gujarat** is the leading producer followed by Andhra Pradesh and Karnataka.
2. **Mustard:** Mustard is a subtropical crop cultivated during rabi season in north-western and central parts of India. It is a frost-sensitive crop and yield fluctuates from year-to-year. **U.P.** is the leading producer followed by Haryana and West Bengal.
3. **Soyabean:** **Madhya Pradesh** is the leading producer of soyabean followed by Maharashtra.

In India, annual oilseeds are cultivated over 26.67 million hectares of area producing 30.06 million tonnes annually (quinquennium ending 2016-17). Majority of oilseeds are cultivated under rainfed ecosystem (70%).



Despite the huge demand, the area under oilseeds has experienced a deceleration in general, and this is due to their low profitability against competing crops like maize, cotton, chickpea etc., under the prevailing crop growing and marketing situations.

The demand-supply gap in the edible oils has necessitated huge imports accounting for 60% of the country's requirements (2016-17: import 14.01 million tonnes; cost Rs 73,048 crore). India is heavily dependent on imports to meet its edible oil requirements and is the largest importer of vegetable oils in the world (15% share) followed by China and U.S.A. Of imported vegetable oils, share of palm oil is 60% followed by soyabean oil with a share of 25% and sunflower with a share of 12%. Most of the edible oil is imported from Indonesia and Malaysia.

Edible Oil Sector

Challenges in meeting the edible oil demand domestically:

1. There has been **stagnation in oilseed production** at around 33 million tonnes over the last 5 years. Reasons for this could be low remuneration for the farmers, reduction in area under cultivation, and absence of Minimum Support Price (MSP).
2. There is a high import dependency which disincentivized domestic production.
3. Oilseeds cultivation in India is **mostly rainfed**. However, the monsoons are highly uncertain and fluctuating in nature and it impacts productivity in general.
4. Majority of oilseed **growers are small and marginal farmers** having poor resource base coupled with non-availability of quality seeds of varieties and hybrids.

Steps which can be taken to enhance domestic production:

1. **Diversification** is required by extending oilseed cultivation to **underutilized farming locations** such as rice fallows of eastern India and in some coastal region.
2. Cooking oil can be brought under the ambit of procurement operations while ensuring affordable supplies.
3. Impetus should be given to **domestic varieties**.
4. There is a need to fix an **annual ceiling on import**.
5. To incentivize palm tree cultivation, **Ashok Dalwai committee** suggested a price incentive mechanism for farmers through creation of an Edible Oil Development Fund (EDOF), with contributions coming from a specially levied Cess of 0.5% on the imports of crude and refined palm oil.

Measures taken by the government to enhance oilseed production:

1. Government **imposes customs duty** on edible oils to safeguard the interests of domestic oil crushing industry.
2. **ISOPOM (Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize)**: Financial assistance is provided to farmers for the purchase of breeder seeds, production of foundation seeds, production and distribution of certified seeds, etc.
3. **National Mission on Oilseeds and Oil Palm (NMOOP)**: The mission targets increasing oilseeds production to 42 MT by Financial Year 2022. The strategy and guidelines for NMOOP includes:
 1. Increasing Seed Replacement Ration (SRR).
 2. Diversification of area from low yielding cereals to oilseeds crops; inter-cropping of oilseeds with cereals/pulses/sugarcane.
 3. Use of fallow land after paddy/potato cultivation.

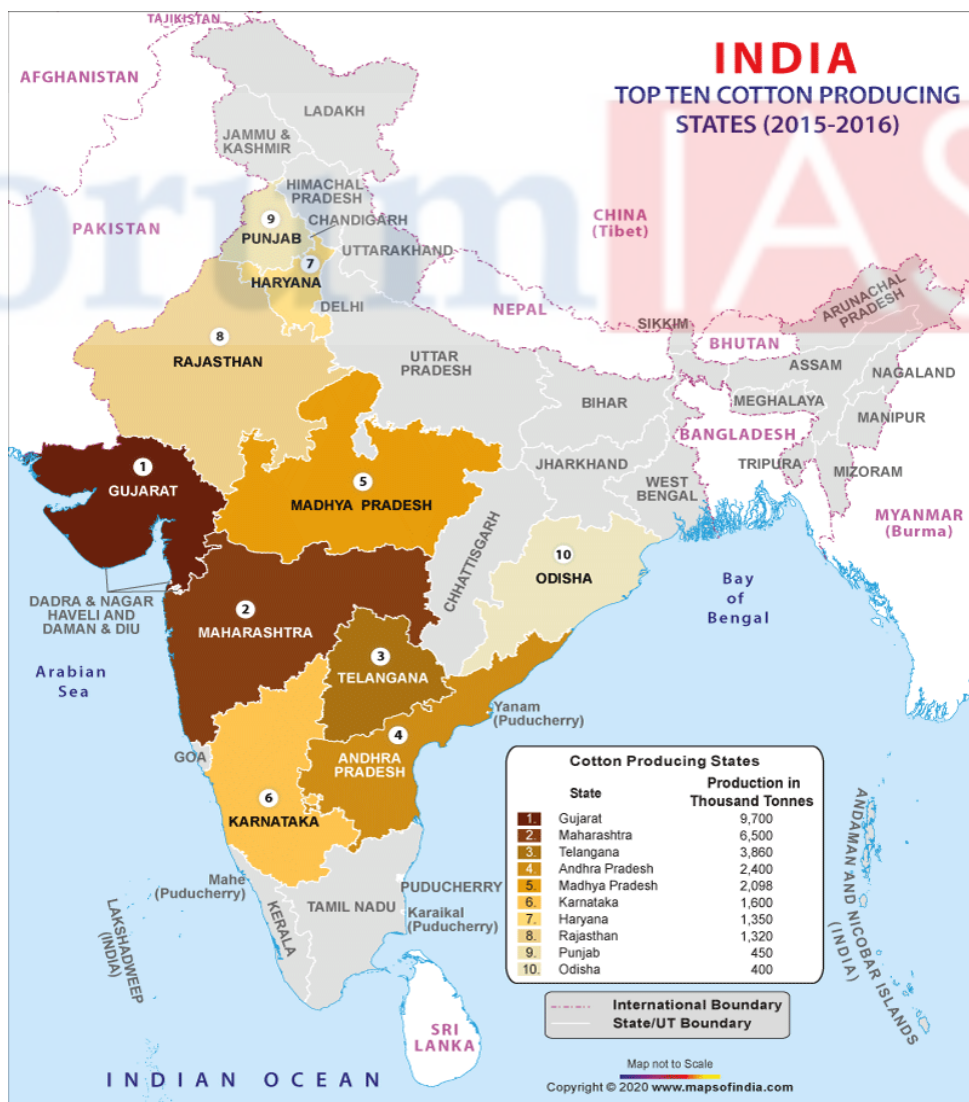
4. Expansion of cultivation of Oil Palm and tree borne oilseeds in watersheds and wastelands.
5. Increasing availability of quality planting material enhancing procurement of oilseeds and collection.
6. Processing of tree borne oilseeds.

3. Fibre crops

Fibre crops provide us fibre for preparing cloth, bags, sacks and a number of other items. **Cotton and jute** are two main fibre crops grown in India.

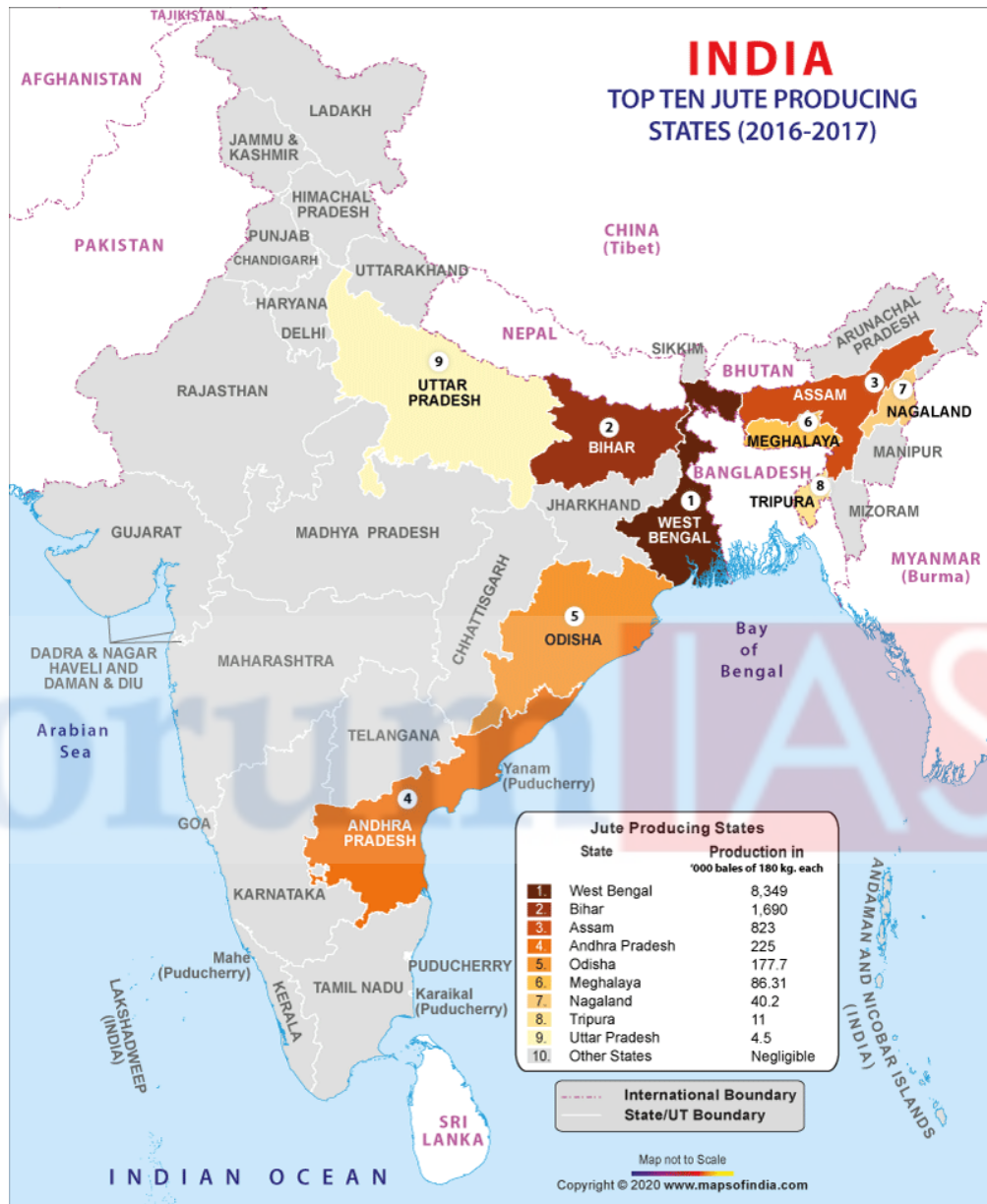
1. **Cotton:** Cotton is a subtropical crop grown in kharif season in semi-arid areas of the country. A hard frost is injurious to it. It requires at least 210 frost-free days and 50-100 cm of rainfall for its growth. India grows both short staple (Indian) cotton as well as long staple (American) cotton called 'narma' in north-western parts of the country. Cotton requires clear sky during flowering stage.

India ranks 4th in the world in production of cotton after China, U.S.A and Pakistan and accounts for about 8.3% of production of cotton in the world. Cotton occupies about 4.7% of the total cropped area in the country with Maharashtra being the largest producer.



Top ten cotton producing states

- Jute:** Jute is used for making coarse cloth, bags, sacks and decorative items. It is a cash crop in West Bengal and adjoining eastern parts of the country. India produces about one-fifth of jute production of the world. **West Bengal** accounts for about three-fourth of the production in the country. Bihar and Assam are other jute growing areas.



Top ten jute producing states

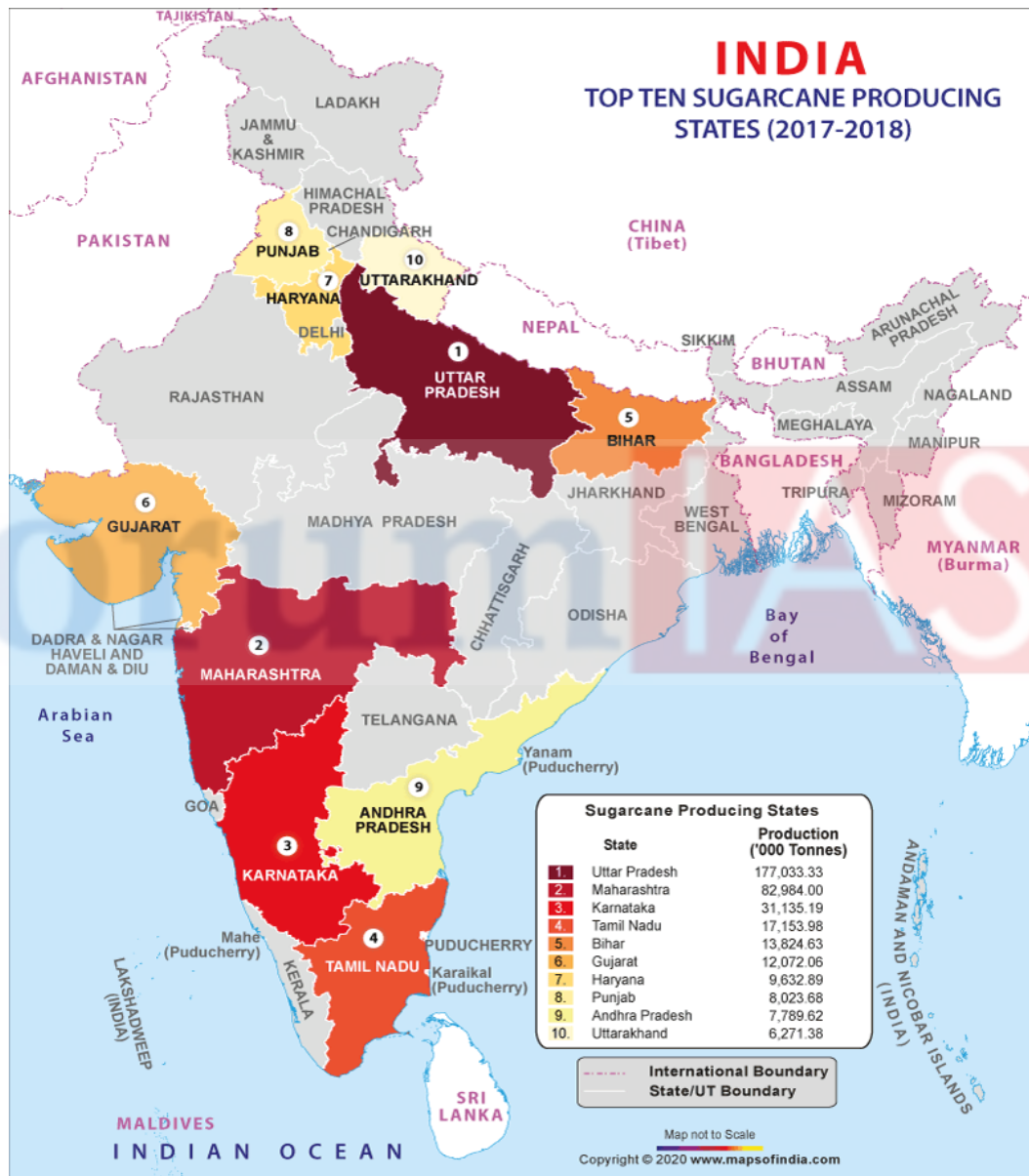
4. Other Crops

Sugarcane, tea and coffee are other important crops grown in India.

- Sugarcane:** Sugarcane is a crop of tropical areas. Under rainfed conditions, it is cultivated in sub-humid and humid climates. But it is largely an irrigated crop in India. India was the second largest producer of sugarcane after Brazil in 2008-09. It accounts for about 23% of the world production of sugarcane. But it occupies only 2.4% of total cropped area.

According to data presented by the Ministry of Agriculture to Lok Sabha, Uttar Pradesh, Maharashtra, and Karnataka have together produced 111 million tonnes of sugar, over 79% of the total production of 139.13 mt in the last years. Uttar Pradesh and Maharashtra together contribute to around 66% of sugar production.

The conventional method of sugarcane cultivation is by stem cutting. However, sugarcane cultivation using settings prepared from tissue culture is also gaining prominence in order to increase its production. Further, under adverse climatic conditions, single-budded setts are likely to suffer more than three-bedded setts.



Top ten sugarcane producing states

2. Tea

Tea is a plantation crop used as a beverage. It is grown over undulating topography of hilly areas and well-drained soils in humid and sub-humid tropics and sub-tropics. India is a leading producer of tea and accounts for about 28% of the total production in the world. At present, it ranks third among tea exporting countries in the world after Sri Lanka and China.

Assam accounts for about 53.2% of the total cropped area and contributes more than half of total production of tea in the country. West Bengal (Darjeeling, Jalpaiguri and Cooch Bihar districts) and Tamil Nadu (Nilgiri and Cardamom hills) are other leading tea producers.

3. Coffee

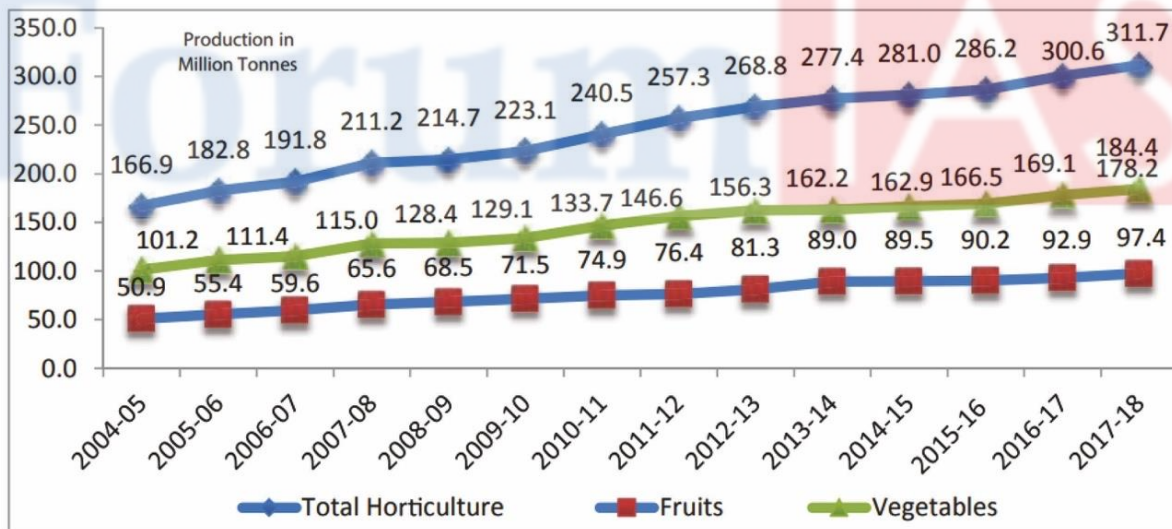
Coffee is a tropical plantation crop. There are three varieties of coffee i.e., arabica, robusta and liberica. India mostly grows superior quality coffee, arabica. But India produces only about 3.2% coffee of the world and ranks seventh after countries like Brazil and Vietnam.

Coffee is cultivated in the highlands of Western Ghats in Karnataka, Kerala and Tamil Nadu. **Karnataka** alone accounts for more than two-third of total production of coffee in the country.

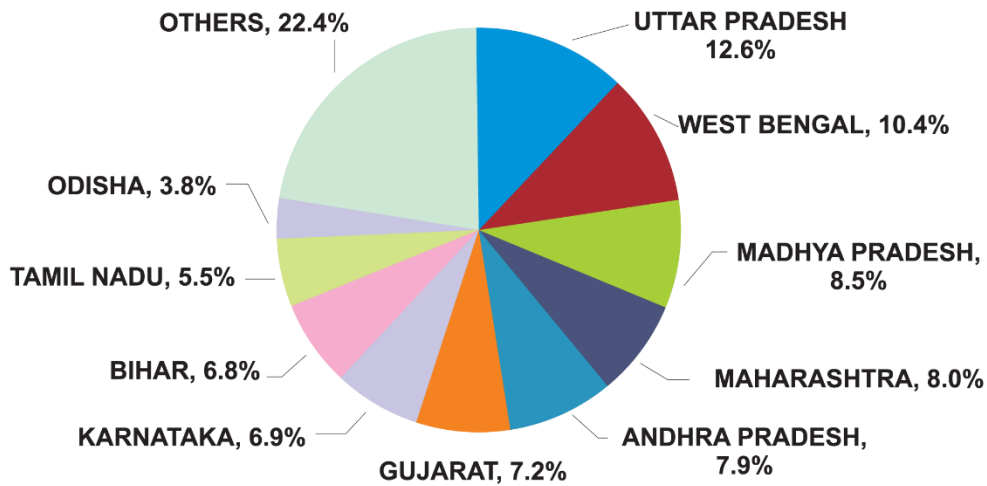
5. Horticultural Crops

Horticulture crops include tree, bush, and perennial vine fruits; perennial bush tree nuts, and vegetables (roots, tubers, shoots, stems, leaves, fruits, and flowers of edible and mainly annual plants).

As per the advance estimates of horticulture production released by the government, production of fruits and vegetables during the year 2018-19 is estimated to be 314.5 million tonnes (MT), about 1% more than what the country produced in 2017-18. The production of fruits and vegetables in 2017-18 was 311.7 MT. While the production of vegetables was estimated to be 187.5 MT, about 3.5% more than that in 2016-17, that of fruits was 97.35 MT, up 4.8% over the previous year.



Horticultural production statistics

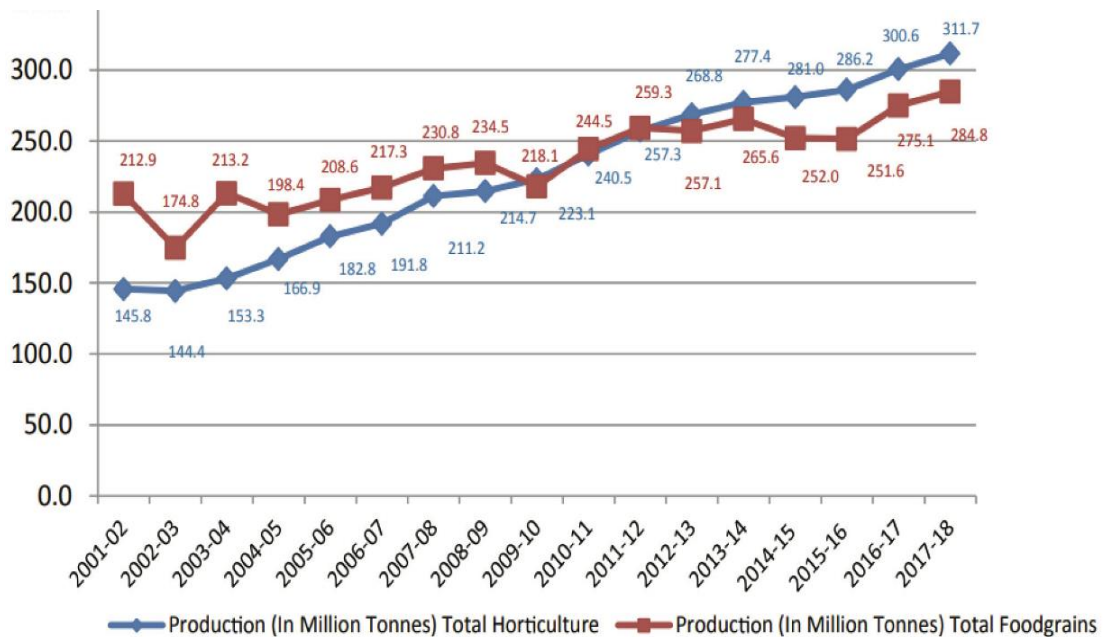


Major horticulture producing states

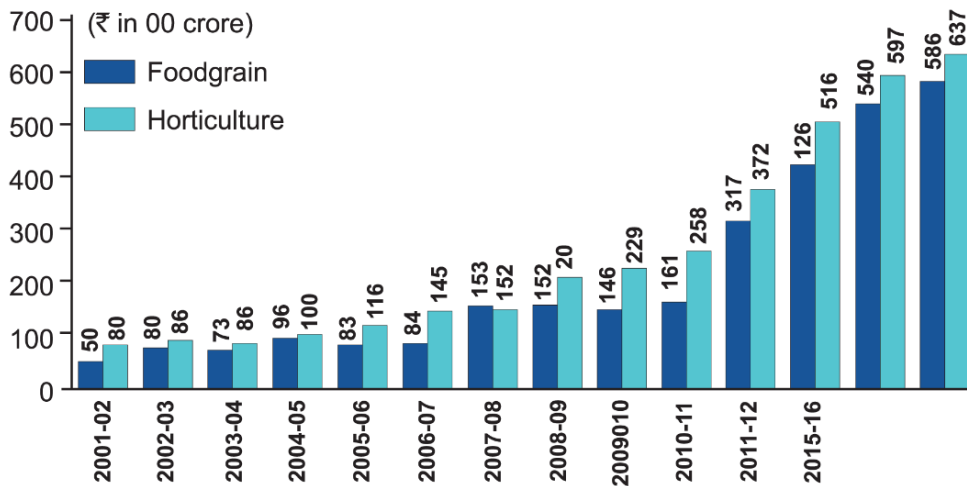
India’s horticulture output has outpaced the production of foodgrains. Horticulture production in India has more than doubled approximately from 146 million tonnes in 2001-02 to 314 million tonnes in 2018-19 whereas **production of foodgrain increased from 13 million tonnes to 285 million tonnes** during the same period.

The area under horticulture crops increased to 25.5 million hectares in 2018-19, which is 20% of the total area under foodgrain. However, the area under total foodgrain declined from 29 million hectare in 2016-17 to 124 million hectare in 2018-19.

Another important point to note is that share of value of export earnings from horticultural crops has been higher than the export value of total food grain.



Horticulture vis-à-vis Foodgrains



Value of export of Horticulture Crops and Foodgrains

Horticulture sector has huge potential in India as:

1. Horticulture crops are characterised by high-value crops, higher productivity per unit of area and lower requirement of irrigation and input cost.
2. They command a **high price in the international market** and can be a crucial source of forex earnings.
3. This sector opens up **employment possibilities** in the primary, secondary and tertiary sector.
4. Horticulture crops are **more resilient** towards change in weather conditions and can counter the increasing uncertainties in climatic patterns like droughts, untimely rains, etc.
5. Horticulture crops **require minimal water**, thus minimizing the risk of crop failure.
6. **Multiple crops** can be planted simultaneously which in turn will increase yields.

National Horticulture Mission (NHM)

NHM is an Indian horticulture scheme promoted by the government of India. While the Government of India contributes 85%, 15% share is contributed by the State Government.

Objectives of the scheme include:

1. To provide holistic growth of the horticulture sector through an area based regionally differentiated strategies.
2. To enhance horticulture production, improve nutritional security, and income support to farm households.
3. To establish convergence and synergy among multiple on-going and planned programmes or horticulture development.
4. To promote, develop and disseminate technologies, through a seamless blend of traditional wisdom and modern scientific knowledge.
5. To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth.

Despite the benefits this sector offers to the Indian agriculture, **there are certain challenges which needs to be addressed** like:

1. **Absence of Minimum Support Price (MSP)** for horticulture crops.
2. Lack of **cold chain infrastructure and storage facilities** which could extend the shelf life of crops.
3. High **price fluctuations** often puts farmers at a risk.
4. Inefficient market intelligence network deprives farmers of the right price for their produce.
5. **Underdeveloped food processing industries** in the horticulture sector.

Government needs to shift its focus towards the horticulture sector through steps like resource allocation, infrastructure development, better policy framework, more Research and Development (R&D) and technological upgradation. Strong forward and backward linkages can stimulate and sustain growth in this sector. Hence, focussing on increasing horticulture production can help double our farmer's income by 2022.

Crop Diversification Programme (CDP)

CDP is being implemented in original Green Revolution States viz: Punjab, Haryana, and Western Uttar Pradesh as a sub-scheme of Rashtriya Krishi Vikas Yojana (RKVY) since 2013-14 to **divert the area of water guzzling paddy to alternate crops** like pulses, oilseeds, maize, cotton and agro-forestry with the objective of **tackling the problem of declining soil fertility and depleting water table in these states**. CDP has been **extended to tobacco growing states** to encourage tobacco farmers to shift to alternate crops/cropping system. Department of Agriculture, Cooperation and Farmers Welfare (DAC&FW) is implementing a CDP.

Under CDP for replacing paddy crops, **assistance is provided for four major interventions:** a) alternative crop demonstrations, b) farm mechanization and value addition, c) site-specific activities, and d) contingency for awareness, training, implementation, monitoring, etc.

3.2 STUBBLE

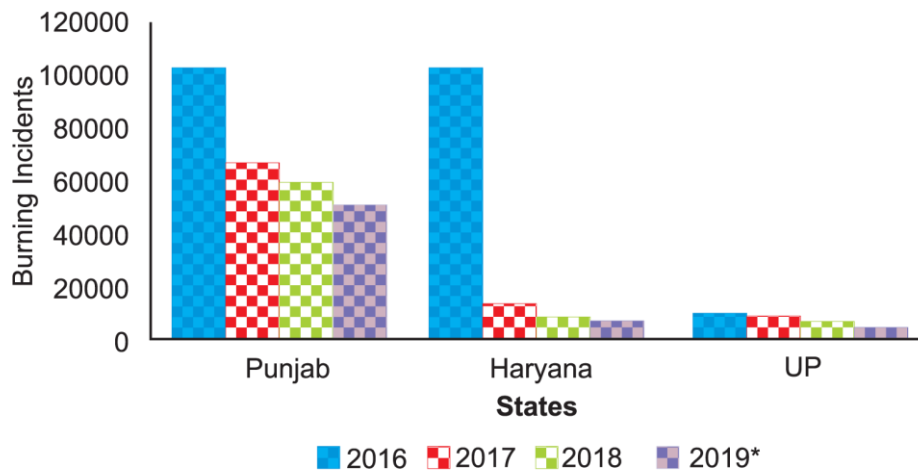
Every year during the months of September and October, farmers of states like Punjab, Haryana, and Uttar Pradesh burn the paddy residue which are left from the previous cropping season. Burning clears the farmland for sowing wheat for next cropping season. This stubble burning results in thick smog, high particulate matter density and air pollution in the Delhi-NCR region. Stubble burning also negatively impacts the soil organic carbon and soil fertility.

To curb stubble burning, a significant contributor to air pollution in North India, following steps have been taken:

1. **National Policy for Management of Crop Residue**, under which National Green Tribunal (NGT), directed and prohibited agricultural residue burning in any part of Delhi, Rajasthan, Punjab, Uttar Pradesh and Haryana. Burning crop residue is a crime under Section 188 of the IPC and under Air and Pollution Control Act of 1981.
2. **Torrefaction**, a Swedish technology that can convert rice stubble into 'bio-coal', is being tested by India.
3. **Promotion of Agricultural Mechanization for In-Situ Management of Crop Residue** is being undertaken under which, agricultural machines and equipment for in-situ crop residue management are provided at a subsidized rate. For e.g., **Happy Seeder machine** has been developed by Punjab Agricultural University (PAU) for in-situ management of paddy stubble.

4. **Pusa decomposer**, a microbial spray that can cause decomposition of the harvested stubble, has been developed by Indian Agriculture Research Institute (IARI).

With various efforts by the government, the total number of burning events have reduced significantly over the years.



Burning incidents in different states

However, continuation of his practice is reported every starting winter and the serious concerns about its impact on air quality is raised. **Following are the reasons which still prompt the farmers to continue with this practice.:**

1. Farmers **lack alternative options** for utilizing the stubble effectively.
2. Many small and marginal farmers **lack necessary resources** to afford the available technology and equipment that can handle the stubble.
3. There is a **general lack of awareness** amongst the farmers regarding the adverse impacts of stubble burning on the environment.
4. Fines and penalties imposed on stubble burning are often not carried out in practice as farmers constitute a major vote bank.
5. Certain laws like the **Punjab Preservation of Subsoil Water Act (2009)** have encouraged this practice. PPSW Act (2009) directs late transplanting of paddy during kharif season to reduce water loss. This resulted in farmers having little time during harvesting and preparing the field for the next crop. Hence, farmers are resorting to the burning of stubble.

To tackle this problem, certain steps could be taken like:

1. **In-situ composting** of crop residues.
2. **Deployment of machines** like Happy Seeder Machine for in-situ management of crop residues. Subsidies should be given to farmers for the purchase of such machines.
3. Promotion of practice of **conservation agriculture** with low lignocellulosic crop residues like rice, wheat, maize, etc. With this, seeds of the next crop can be sown without any problem associated with residues of the previous crop and also without affecting the crop productivity.
4. **Creation of markets for crop residue-based briquettes** so that farmers could sell their crop residues and also get remuneration.
5. Promotion of use of crop residue-based biochar briquettes in local industries, brick kiln and hotel/dhaba as an alternate fuel.

CHAPTER 4

AGRI-SELLING

4.1 AGRICULTURAL SUBSIDIES AND MSP

4.1.1 AGRICULTURAL SUBSIDIES

An agricultural subsidy is a government incentive paid to agribusinesses, agricultural organizations and farms to supplement their income, manage the supply of agricultural commodities, and influence the cost and supply of such commodities.

Agricultural subsidy acts as an incentive to promote agricultural development in India. It helps stimulate agricultural production and attain self-sufficiency. Further, subsidies also contribute to better cropping pattern, employment and income of beneficiaries.

There are **different types of agricultural subsidies** being provided in India:

1. **Explicit Input Subsidies:** They are payments made to the farmers to meet a part of the cost input. For e.g., subsidy on improved or high yielding variety seeds, fertilizers, and plant protection chemicals for certain crops.
2. **Implicit Input Subsidies:** They are hidden in nature. In the implicit input subsidies, prices of inputs are administratively determined, and priced low compared to their economical cost.
3. **Output Subsidies:** This type of subsidy is provided in order to encourage the output of a particular product by partially offsetting the production cost or losses. The objective of this subsidy is to expand production of a particular product more so that the market would promote but without raising the final price to customers.
4. **Food Subsidies:** The difference between the per quintal economic cost and the per quintal Central Issue Price (CIP) gives the quantum of food subsidy. Food subsidy comprises of subsidy provided to Food Corporation of India (FCI) for procurement and distribution of wheat and rice and for maintaining the strategic reserves of foodgrains and subsidy provided to states or undertaking decentralized procurement.

As per the Economic Survey 2020, food subsidy incurred by the government has risen substantially over the years from about 0.6 lakh crore in 2009-10 to about 1.7 lakh crore in 2018-19.

Agricultural subsidies can also be categorized on the basis of Mode of Payment:

1. **Direct Subsidies:** Direct subsidies are money transfers by the government that reach the ultimate beneficiary through a formal predetermined route. Direct subsidies increase the beneficiary's buying power and helps raise the living standards. In agriculture, direct subsidies help farmers buy the necessary inputs from the market. For e.g., PM KISAN, Minimum Support Price (MSP) and Direct Benefit Transfer (DBT).

2. **Indirect Subsidies:** Indirect subsidies are provided through price reduction, welfare and other ways but do not include a direct cash payment. They reach the farmers along with the use of inputs. Farmers get the subsidized product while the subsidy amount is provided to the provider of the product. For e.g., fertilizer subsidy, power subsidy, water subsidy, etc.

Indirect subsidy offers certain benefits like:

1. In the absence of information availability, farmers may not be able to make the right choices with the direct subsidy being provided. Hence, indirect subsidy is a way of government making the right choices for the farmers.
2. There is no wastage of money unlike the case with direct subsidies where cash is provided directly to the farmers and he may waste it on non-productive activities like alcoholism.
3. It helps prevent inclusion-exclusion error.
4. Indirect subsidies are easier to monitor.
5. Government can better exercise control over the agency being provided the subsidy rather than directly dealing with individual farmers.

Government subsidies have a vital role to play in agriculture sector development. The impact is practically visible on both the production and distribution. However, **there are certain issues related to the agricultural subsidies.**

1. Agricultural subsidies lead to a heavy **fiscal burden** on the government. The total outgo on fertilizer subsidy alone in 2017-18 was Rs. 70,000 crores.
2. Power subsidy has led to **overuse of groundwater** which has further resulted into dramatic fall in ground water levels.
3. Due to the fertilizer subsidy being offered, there has been an **indiscriminate use of fertilizers** by the farmers. This has led to a **decline in soil fertility** and an overall reduced agricultural productivity.
4. Fertilizer subsidies are generally **cornered by the manufacturers and the rich farmers** of Punjab and Haryana and it fails to provide benefits to the targeted groups, especially small and marginal farmers.
5. Price subsidies like Minimum Support Price (MSP) are **cereal centric** (rice, wheat etc.) and have neglected pulses, oil seeds and coarse cereals.
6. Most of the subsidies are **regionally biased** and have benefitted the rich states which are able to grow marketable surplus and have well developed infrastructure. States like Bihar and Eastern U.P have failed to derive similar benefits.

In order to resolve the various issues related to agricultural subsidies, following steps could be taken:

1. Better targeting of subsidies with the usage of JAM (JanDhan-Aadhar-Mobile Number) trinity can reduce the fiscal burden.
2. Government needs to rationalize certain subsidies like power subsidy to check indiscriminate exploitation of groundwater.
3. Promotion of soil health card, organic farming and neem coated urea can reduce the quantum of fertilizers used in agricultural fields. This will rationalize the fertilizer subsidies which has already put a heavy fiscal strain on the government.
4. Direct Benefit Transfer (DBT) of subsidies through Aadhar authentication will solve issues like inclusion-exclusion errors and ensure better targeting of beneficiaries.
5. Crop diversification by including more crops under Minimum Support Price (MSP) will benefits such farmers growing those crops.

Agricultural Subsidies and World Trade Organization (WTO)

Some of the notable agreements under the WTO are as follows:

1. **Agreement on Sanitary and Phytosanitary Measures (SPS)** sets out the basic rules for food safety and animal and plant health standards.
2. **Agreement on Agriculture (AoA)** under which, 1st and 3rd world countries are required to limit their food subsidies to 5% and 10% respectively to the value of their agriculture production in 1986.
3. **Peace Clause** which gives temporary immunity India and other developing countries to continue their respective food subsidy programs and protects them from being challenged under other WTO agreements by countries like U.S.A.

Agreement on agriculture (AoA) aims to regulate the agricultural subsidies through its “box” mechanism.

1. “**Green Box** (subsidies that don’t disrupt trade or only cause minimum damage to trade balance)” and “**Blue Box** (subsidies that aim to limit production and don’t increase with production)” subsidies are allowed. E.g., subsidies given for research and cattle-vaccination.
2. “**Amber Box**” subsidies are subjected to quantitative limits as they are trade distorting in nature. E.g., subsidies on diesel, electricity and fertilizer, Minimum Support Price (MSP) etc.

India’s stand on WTO rules

The Government of India has cited two main reasons for its push towards agricultural subsidies:

1. India has a large population of poor farmers who require government support in the form of subsidies and procurement at Minimum Support Price (MSP).
2. India has a large population of malnourished poor families who need subsidized food grains under National Food Security Act (NFSA).

India’s public stockholding programme and MSP have been hotly debated at the WTO between the developed and developing blocs. The US and Canada alleged in 2018 that India “substantially underreported its market price support” for five types of pulses. Further, Canada, the US and Australia complained that India has not declared its agricultural export subsidies for more than eight years.

Also, in 2020, India had to invoke the “Peace Clause”- which prevents WTO members from initiating complaint against a developing country for compliance with certain obligations- because India exceeded “the ceiling on support it can offer farmers for rice for the marketing year 2018-19”. This was the first time any country has taken recourse to this safeguard and this has fueled further debates in WTO surrounding India’s farm subsidy policies.

However, India has maintained its stand that it has always complied with WTO rules. India has continuously defended its position on this issue and emphasized the need to prioritize the food and livelihood security of its population. Also, on the issue of its food subsidy being violative WTO norms, India has dismissed these allegations and demanded that Market Price Support (MPS) should be calculated by using a recent reference year instead of 1986 as provided under the AoA.

In 1986, India's agricultural production was much lower than countries like U.S.A., so even in absolute quantitative terms, U.S.A.'s 5% will be much bigger than India's 10%. As a result, 1st world countries are able to give larger amount of subsidies to their farmers, which is unfair.

4.1.2 AGRICULTURE PRICING POLICIES

India's agricultural price policy includes three main types of administered prices: support, procurement, and issue price.

1. **Minimum Support Price (MSP):** It is an agricultural produce price, set by the Government of India to purchase directly from the farmer. This is not enforceable by the law. By definition, this rate is to safeguard the farmer to a minimum profit for the harvest, if the open market has a lesser price than the cost incurred. MSP is fixed on the recommendations of the Commission for Agricultural Costs and Prices (CACP), an attached office of the Ministry of Agriculture and Farmers Welfare and announced before the sowing season.

As of now, the **MSP is offered on 23 commodities:**

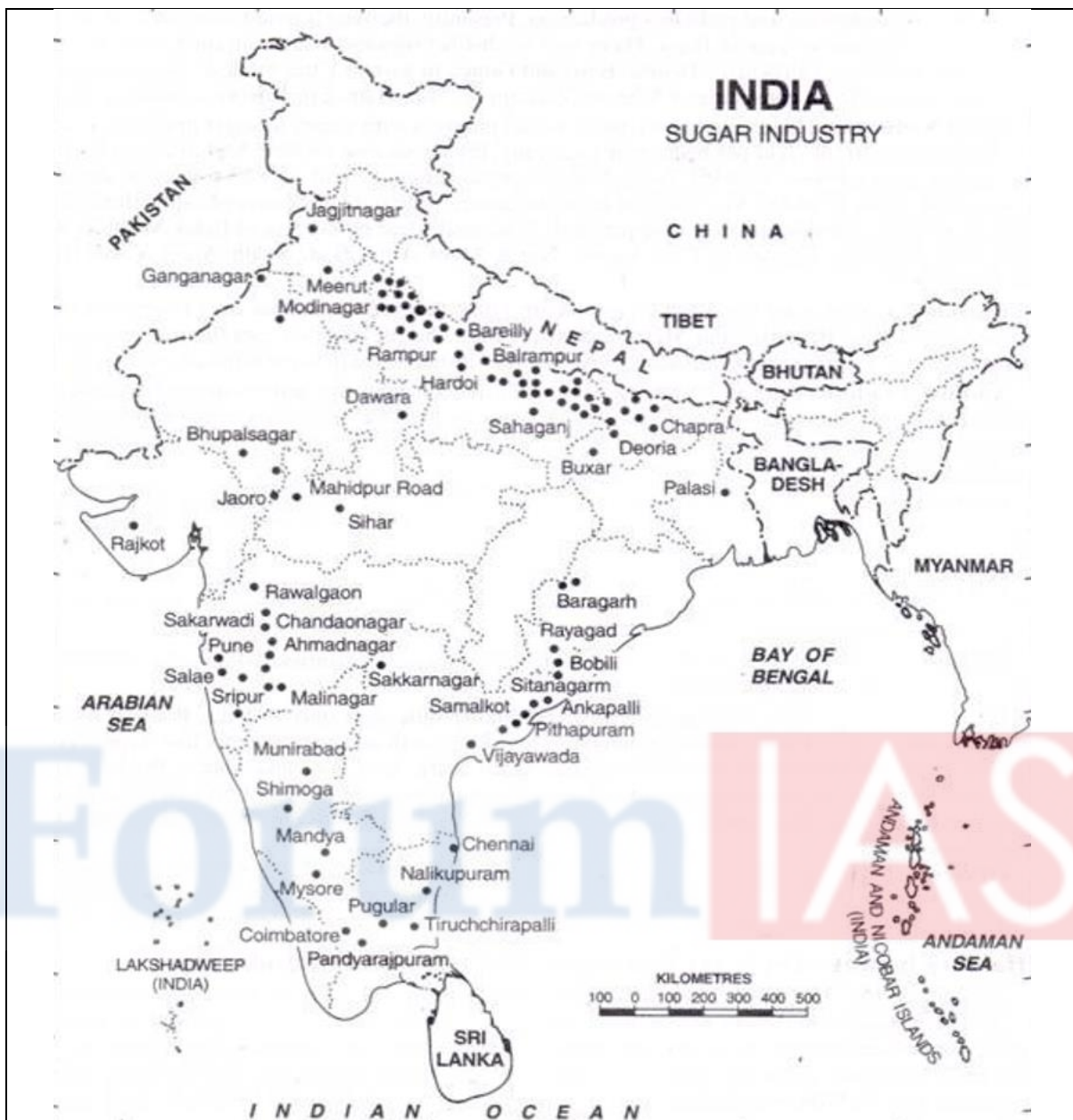
1. 7 cereals (paddy, wheat, maize, sorghum, pearl millet, barley, and ragi)
2. 5 pulses (gram, tur, moong, urad, and lentil)
3. 7 oilseeds (groundnut, rapeseed-mustard, soyabean, sesame, sunflower, safflower and nigerseed)
4. 4 commercial crops (copra, sugarcane, cotton, and raw jute)

For sugarcane, the mechanism is a bit different. It requires the sugar mill companies to pay a **Fair and Remunerative Price (FRP)** fixed by the government whereas for other crops, government itself procures at MSP.

Sugar industry

The pricing of sugar is governed by the statutory provisions of the Sugarcane (Control) Order, 1966 issued under the Essential Commodities Act, 1955. There are **two mechanism of sugarcane pricing** followed in India:

1. **Fair and Remunerative Price (FRP):** It is the cane price fixed by the CACP after consulting the state governments and associations of sugar industry. FRP is the minimum price paid by the mills to the farmers.
Parameters considered for FRP include- recovery of sugar from sugarcane, cost of production of sugarcane, price at which sugarcane is sold by producers, availability of sugar to customers at fair price, reasonable profit margins for growers, revenue realization from sale of by-products like molasses, and return of the growers from alternate crops.
2. **State Advised Prices (SAPs):** Citing differences in cost of production, productivity levels and also as a result of pressure from farmers' groups, some states declare state specific sugarcane prices called SAPs, usually higher than FRPs.



Distribution of sugar industry in India

Some recent steps taken by the government to promote the sugar industry are as follows:

1. The import duty was increased from 50% to 100%, along with the removal of 20% export duty. The government had earlier allowed export of two million tonnes of sugar until the end of the 2017-18 marketing year, in order to clear surplus stocks and improve cash flow to millers for making payment to sugarcane farmers.
2. Government introduced duty free import authorization scheme under which exporters are allowed to import sugar at zero duty within three years.
3. Stock holding limits were placed on the sugar mills.
4. Buffer sugar stock of 30 lakh tonnes were built.
5. The government introduced production subsidy, transport subsidy, and 50 lakh tonnes export quotas.
6. New Biofuel Policy in 2018 allows sugar mills to make ethanol from cane juice, molasses, foodgrains, potatoes, etc.

However, the **sugar industry in India continues to face certain problems** like:

1. Although India has the largest area under sugarcane cultivation, the **yield per hectare** (around 64.5 tonnes/hectare) **is extremely low** as compared to some of the major sugarcane producing countries of the world (around 90 tonnes/hectare of Java).
2. Due to **short crushing season** of sugarcane, the mills and its workers remain idle during most part of the year, creating financial problems for the industry as a whole.
3. **Fluctuating sugarcane production** affects the supply of sugarcane to the mills.
4. The **average rate of recovery of sugar** in India is less than 10% which is quite low as compared to other major sugar producing countries (recovery rate is as high as 14.16% in Java).
5. High cost of sugarcane, inefficient technology, uneconomic process of production, and heavy excise duty result in high cost of production. The **production cost of sugar** in India is one of the highest in the world.
6. Most of the sugar mills in India are of small size with capacity of 1000 to 1500 tonnes per day. This makes large scale production uneconomic.
7. Most of the **machinery used** in Indian sugar mills are **old and obsolete**, some being 50-60 years old and needs rehabilitation. But low profit margins prevent sugar mill owners from replacing old machinery by new one.
8. Sugar industry in India faces **competition** with Khandsari and Gur
9. Over half of the sugar mills are located in Maharashtra and Uttar Pradesh, with these two states accounting for about 60% of the production. This leads to **regional imbalances**.
10. The **per capita annual consumption** of sugar in India is only 16.3 kg as against 48.8 kg in the U.S.A, 57.1 kg in Australia and so on.

The **MSP of a crop is based on the following considerations**:

1. Cost of production
2. Demand and supply
3. Price fluctuations
4. Market price trends
5. Different costs
6. International market prices
7. Agricultural wage rate

Government of India adopts the “**A2+FL**” formula for calculating the MSP. Cost A2 includes the actual costs paid by the farmers for purchase of various inputs like seeds, fertilizers, pesticides, hired labor, rent of land & machinery, if hired. Cost FL refers to the cost of family labor. Adding both costs give the A2+FL cost. MSP is 1.5 times the A2+FL cost.

The **major objectives of the MSP policy are** to support the farmers from distress sale and to procure food grains for public distribution. Further, such minimum support prices are fixed at an incentive level, so as to induce the farmers to make capital investment for the improvement of their farm and to motivate them to adopt improved crop production technologies to step up their production and thereby their net income. The policy of MSP has other beneficial outcomes like income security to farmers bringing investment into agriculture, building up buffer stocks for public distribution, stabilizing food prices in the open market and consumer welfare.

However, **there are some issues associated with the MSP policy:**

1. MSP is higher for wheat and rice compared to that of cereals and pulses. So, farmers are more incentivized for growing profitable crops and hence **cropping pattern gets distorted**.
2. There has been continuous hike in MSP and Procurement Prices due to rich farmers' lobby which has contributed to **inflationary trends**.
3. Food Corporation of India (FCI)/NAFED **procurement at MSP** is usually confined to big towns and districts. Farmers in remote and tribal areas are unable to bring their produce to the procurement agencies due to high transportation cost.
4. Rise in the price of cereals (due to higher MSP) leads to significant burden of **high cost for the buyer**. This has a negative impact on rural poor.
5. 95% of the procurement of wheat at MSP is from Punjab, Haryana, and Western UP. Other states do not get much benefit from it.
6. Procurement by the government under MSP leads to **fiscal squeeze**.
7. Due to extra expenditure in food procurement, the other sectors lose out on new investments.

Owing to the above issues, **following reforms can be implemented:**

1. Scientist MS Swaminathan had suggested **C2 formula for computing MSP**. C2 formula computed lot of costs, including imputed rent on his own land, imputed interest on his own capital, etc. Using the C2 formula would increase the MSP amount.
2. Procurement under MSP should be at **market driven prices** so that it does not distort market prices and cause inflation.
3. Since **agriculture is a state subject**, states should be consulted while deciding MSP amount.
4. Since MSP is announced just before the sowing season, many farmers, especially small and medium farmers miss out on the notification. The MSP system can only be effective if the **producers are aware of the MSP well in advance**.
5. A **robust network of procurement agencies** should be available for the farmers to sell their produce. Government introduced decentralized procurement in this regard. **States which adopted decentralized procurement (DCP) include:** A&N Islands, Karnataka, Kerala, Odisha, Tamil Nadu, Andhra Pradesh, Telangana, Maharashtra, and Jharkhand (for **rice**); Gujarat, Punjab, and Rajasthan (for **wheat**); Bihar, Chhattisgarh, Madhya Pradesh, Uttarakhand, and West Bengal (for **rice/wheat**).
6. More coarse cereals should be brought under the ambit of the MSP to **encourage diversification of crops**.

PM-AASHA (Pradhan Mantri Annadata Aay Sanrakshan Yojana)

PM-AASHA is a Central Sector Scheme launched by the agricultural ministry with the following three components:

1. **Price Support Scheme (PSS):** Central agencies will do physical procurement of pulses, oilseeds, and copra.
2. **Price Deficiency Payment Scheme (PDPS):** In this, direct payment of the difference between the MSP and the selling/modal price will be made available to pre-registered farmers selling his produce in the notified market yard through a transparent process. Under PDPS, it is

proposed to cover all oilseeds for which MSP is notified. This scheme does not involve any physical procurement of crops as farmers are paid the difference between the MSP price and sale/modal price on disposal in notified market.

3. **Pilot of Private Procurement and Stockist Scheme (PPPS):** Under this, private agencies will be hired on the behalf of the government to procure commodities at MSP.

2. **Procurement Prices:** They are higher than MSP and are meant essentially for the purchase of quantities needed by the government to maintain its Public Distribution System (PDS) and for building up the Buffer Stock. Food Corporation of India (FCI), the nodal central agency of the Government of India, along with other state agencies undertakes procurement of wheat and paddy.

The process of procurement is known as “**Open Ended Procurement**” where central agencies like FCI and National Agricultural Cooperative Marketing Federation of India Ltd. (NAFED) purchase the entire quantity of foodgrains offered by the farmers at MSP. Collectively, this entire mechanism is known as **Market Intervention Scheme and Price Support Scheme (MIS-PSS)**.

3. **Issue Price:** These indicate prices at which the government supplies food grains through fair price shops and ration depots.

4.2 PUBLIC DISTRIBUTION SYSTEM, BUFFER STOCKS AND FOOD SECURITY

4.2.1 PUBLIC DISTRIBUTION SYSTEM IN INDIA (PDS)

Public distribution system in India is a government sponsored chain of shops entrusted with the task of distributing basic food and non-food items to the needy sections of the society at very cheap prices. The PDS distributed commodities worth more than Rs 98,000 crore in 2014-15 through 5.21 lakh fair price shops. Rice, wheat, sugar, and kerosene have been the four major items of distribution under PDS.

Objectives of PDS are:

1. To provide essential consumer goods at cheap prices to the consumers.
2. To insulate them from the rising impact of prices of such commodities.
3. To maintain minimum nutritional status of our population.
4. To put indirect check on the open market prices of various commodities.

Public distribution system in India has evolved drastically since the time it was introduced in India.

1. **Targeted Public Distribution System (TPDS):** It was introduced in 1997 and under it, license was given to panchayats, self-help groups, cooperatives, and individuals to open fair price shops/PDS shops. Beneficiaries can buy commodities like subsidized grains from such shop using their ration cards.
2. **Antyodaya Anna Yojana (AAY):** It aimed at providing 35 kg subsidized grains for the poorest of poor family at a highly subsidized rate of Rs 2/kg of wheat and Rs 3/kg of rice.

3. **National Food Security Act (NFSA):** It is a Central Sector Scheme enacted in 2013 by the **Department of Food and Public Distribution under the Consumer Affairs Ministry**. The scheme aims to provide subsidized food grains to poor families. Union procures food grains from farmers at **MSP** and sells it to the states at **Central Issue Price (CIP)**. States then sell the grains to the beneficiaries through fair price shops/PDS shops.

67% of the Indian population is covered under the scheme, including 75% rural population and 50% urban population (both Below Poverty Line and few Above Poverty Line families are covered). The beneficiaries are provided rice at Rs 3/kg, wheat at Rs 2/kg, and coarse grains at Rs 1/kg.

The **eldest woman in a household**, of age 18 years or above, is considered the head of the household for issuing ration card. This has been done to promote women empowerment. Further, **pregnant and lactating women** are entitled to “take home ration” of 600 calories per day during pregnancy and six months thereafter.

NFSA seeks to provide **food and nutritional security** in human life cycle approach, by ensuring access to adequate quantity of quality food at affordable prices to people to live a life with dignity. The Act brings Right to food within the framework of legally mandated entitlements. However, **NFSA is faced with a certain set of challenges which has prevented it from achieving its full potential:**

1. It will cost around 1.3 lakh crore or 1.3% of GDP at current market prices to provide annual subsidy under NFSA, leading to fiscal squeeze.
 2. Improper identification of beneficiaries often leads to inclusion-exclusion errors.
 3. There has been a rise in leakages in schemes like PDS due to rampant corruption.
 4. Annual production of foodgrains is not sufficient to meet the requirements of NFSA. This has been accentuated by the inefficient procurement system of FCI and other central and state agencies.
4. **One Nation One Card:** This scheme aims to connect all ration cards to a central server and provide Point of Sale (PoS) machines to all PDS shops. Doing this will enable all beneficiaries under NFSA to buy grains from any PDS shop in the country, irrespective of the state to which he belongs. The scheme will especially benefit the seasonal migrant workers.

Issues with PDS in India:

1. After the inclusion of NFSA-2013, the burden of **food subsidy has become huge**. The procurement prices have been rising continuously due to rich farmers' lobby and issue prices are getting lower due to populist policies. All of this together have made PDS unsustainable.
2. **Inefficiencies in the operations of Food Corporation of India (FCI)** due to highly centralized and bureaucratic mode of operations have resulted in an increase in the economic cost of FCI food grains operation.
3. For a long period of time, PDS operations have remained **limited mostly to urban areas** and rural poor have not benefitted much from PDS.
4. Since there is a residential requirement for ration cards, a large number of homeless people, migrants, etc. are automatically left out of food security.
5. PDS suffers from **leakages due to diversion** of foodgrains to the open markets because of widespread prevalence of corruption. NSSO data shows a huge leakage of 37% from PDS in 2011-12.

6. Due to large procurement of foodgrains every year by the government, the net quantities available in the open market reduces. This leads to increase in the price of commodities and inflation.
7. Improper targeting of beneficiaries has led to **inclusion-exclusion errors**. As per NSS-2007, 63% of the poor households were not covered under the TPDS system. Further, NCAER reported about “ghost” card holders/ghost beneficiaries.

Recent PDS reforms

1. Digitization of all of 23 crore ration cards.
2. 56% of the digitized cards have been seeded with Aadhar.
3. Installation of e-PoS (electronic Point of Sale) devices at fair price shops to track the sale of foodgrains to actual ration card holders on a real time basis.

Some of the changes or reforms which can be introduced in the PDS system to improve its functioning include:

1. **Shanta Kumar committee** in 2015 recommended **gradual introduction of cash transfers** in PDS, starting with large cities with more than 1 million population.
2. **Food coupons** can be provided to beneficiaries through which they can buy foodgrains from store, and the dealer could be reimbursed on production of these coupons at the govt treasure. This will help reduce the problems of procurements, diversion and black marketing of food grains.
3. Instead of buying through PDS, government should provide a **universal basic income** to all so that the needy could purchase foodgrains as per their choice.
4. **Private sector** should be encouraged to take up procurement, storage and distribution of foodgrains. This would ease the pressure on government agencies and increase efficiency.
5. Government should **diversify its procurement basket** so as to incorporate adequate nutrient mix. This will promote crop diversification and check the skewed incentive to grow only rice and wheat.
6. **Technological intervention** is the need of the hour in the PDS system. For e.g., truck dispatch information and stock availability at fair price shop through SMS to registered users and GPS based tracking of trucks carrying PDS goods can be implemented.
7. Fair price shops can be operated with the help of panchayats, cooperatives and self-help groups will lead to **community participation** and localized monitoring of PDS scheme.
8. **Proper identification of beneficiaries** will improve targeting. Creating a web database of beneficiaries with information on the allotted quantity of each good as per entitlement, computerized entry via Aadhar authentication at Point of Sale (PoS) machines, etc. can be done.

4.2.2 BUFFER STOCKS

Food Corporation of India (FCI) is a statutory corporation set up under the Consumer Affairs Ministry. It procures foodgrains from farmers at MSP, distributes foodgrains to consumers through PDS, and maintains buffer stock for food related schemes and to meet emergency situations like unexpected crop failure, natural disasters, festivals, etc. Buffer stocks are fixed by Cabinet Committee on Economic Affairs (headed by the PM). Central pool stocks under buffer stock were 74.3 million tonnes on July 1, 2019.

However, **there are certain issues with buffer stock policy of India:**

1. Government procures around 40-50% of the total marketable surplus of rice and wheat, making the government a virtual monopsonist in domestic grain market. This has led to the **government becoming the single largest hoarder of rice and wheat**. This in turn disincentivizes the private sector to make long term investment in procurement, storage, and processing.
2. As per the Economic Survey 2020, India has become a high-cost food grain economy due to **high procurement costs**.
3. Further, the **inefficiency of FCI** increases with increasing levels of stock it has to store.
4. Also, India **lacks storage infrastructure** needed to maintain its rising buffer stocks.
5. Government intervention in the grains market has created **a disconnect between demand and supply** as the farmers are deriving their signals from the government policy on procurement and distribution rather than the demand patterns.

Inefficiencies of Food Corporation of India (FCI)

The economic cost of food grains to the FCI is the MSP along with bonus (if any) paid to the farmers plus procurement incidentals (paid to drivers, loaders, etc.) and distribution costs (like delivering to states for their public distribution system shops, implementing NFSA, etc.).

However, **FCI is faced with a set of challenges** like:

1. **Inefficient inventory management** by the FCI leads to an excess of millions of tons of grains remaining in the FCI godowns leading to wastage of food.
2. FCI lacks sufficient **storage infrastructure**. As a result, the quantity purchased exceeds the storing capacity of FCI and leads to excessive damage of procured grains.
3. FCI's **cost of operations** are rising due to higher acquisition cost and storage costs. It has been observed that the economic cost of FCI for acquiring, storage, and distributing food grains is about 40% more than procurement price.
4. While the economic cost of FCI is increasing due to increased procurement, the government is not releasing subsidy/funds to the FCI in a timely fashion. As a result, FCI suffers from **financial crunch**.
5. FCI is presently overburdened due to **negligible private sector participation** in the food grain sector.
6. **Human resources related issues** like staff shortages, lack of technical expertise, etc. plagues the FCI.
7. FCI also suffers from red tapism, corruption and bureaucratic hurdles.

Shanta Kumar Committee recommendations on restructuring of FCI can be implemented to improve its functioning:

1. FCI should hand over procurement to those states which have gained sufficient experience (like Andhra Pradesh, Punjab and Haryana). It should focus on states which suffer from distress sale at prices much below MSP, and which are dominated by small landholdings.
2. FCI should **outsource its stocking operations to the private sector**. Even the Economic survey 2020 has stated that government intervention has hurt more than it has helped and that it has no business to be in business.

3. A **transparent liquidation policy** is the need of the hour, and it should automatically kick in when FCI is faced with surplus stocks than buffer norms.
4. At the top level, FCI should hire executives from the private sector to bring in **technical expertise**.

Some of the **steps which could be taken to improve the buffer stocks policy of India** are as follows:

1. **Economic Survey 2020** recommends the following:
 - a. Coverage of NFSA should be restricted to the bottom 20% of the economic ladder.
 - b. Moving towards conditional cash transfers (CCT) under which poor families are given money to buy non-subsidized foodgrains from the market. This would reduce FCI's procurement and stock keeping burden.
2. **Open Market Sale Scheme (OMSS)** of excess foodgrains beyond the storage capacity should be implemented to avoid wastage.
3. **Cold storage infrastructure** needs to be built so as to conserve the perishable commodities. Private sector could be encouraged under Public Partnership Model (PPP) to build such physical infrastructure.
4. **Negotiable Warehouse Receipts (NWR)** needs to be implemented as it will considerably reduce the storage costs and responsibility of the government.. Under NWR, farmers deposit his produce into Warehousing Development and Regulatory Authority (WRDA)'s registered warehouses and gets negotiable warehousing receipts. He can then pledge his NWR to obtain loans from the banks for the next cropping cycle or trade it via the commodity exchange markets. NWR prevents distress sale of agricultural produce. Farmers can wait for the prices to rise before selling while his crop is safely stored in the warehouse.

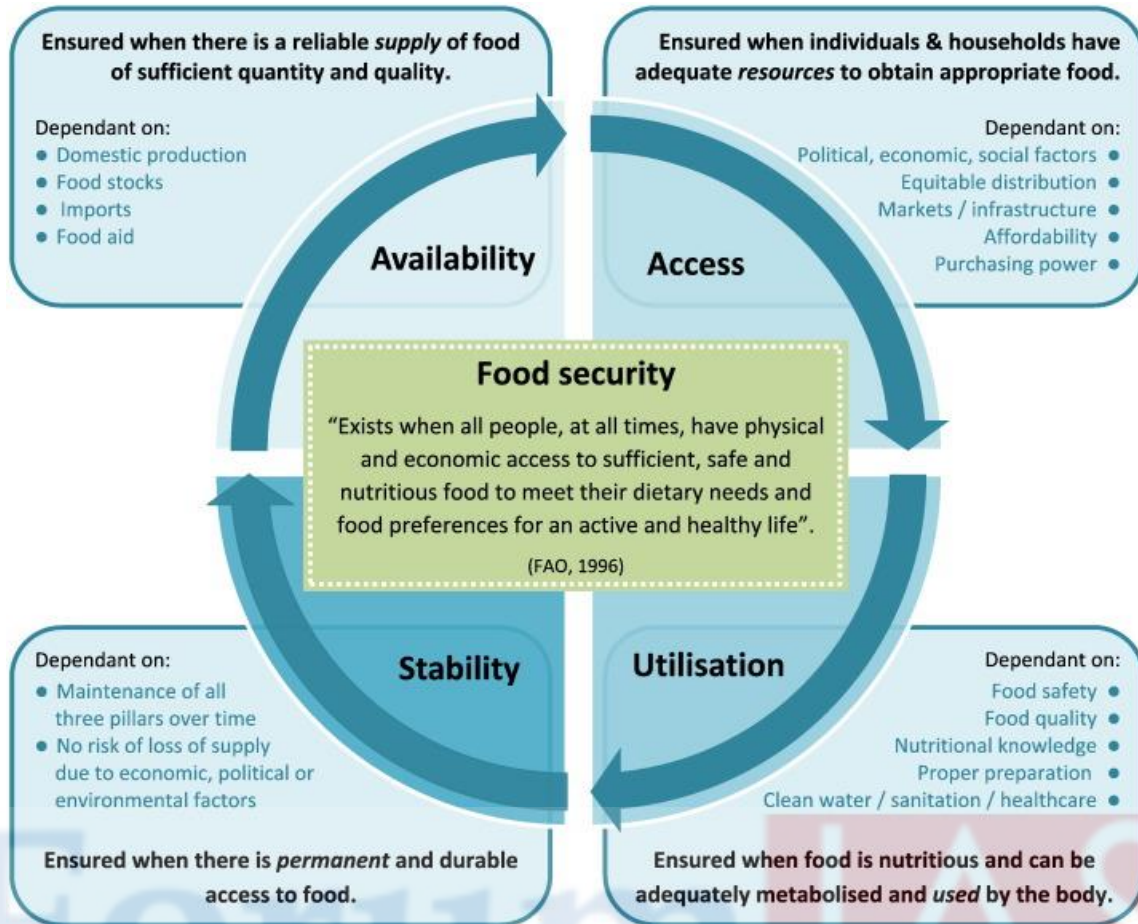
WRDA is a statutory authority under the Department of Food and Public Distribution, Government of India. It implements and regulates the Negotiable Warehouse Receipt (NWR)/electronic-NWR (e-NWR) system in the country. WRDA also promoted the orderly development of the warehousing business in India.

5. Restructuring of FCI based on Shanta Kumar committee's recommendations can be done to improve its efficiency.

4.2.3 FOOD SECURITY

FAO defines food security as ensuring that all people at all times have both physical and economic access to the basic food that they need.

Food security is important for an economy because only when citizens are fit and secure, they can engage in productive activities and increase the economy of the country. A food secure nation is able to reap the benefits of its demographic dividend to its fullest extent. Further, when the nutritional status of citizens is high, government's spending on healthcare reduces and this would open up scope for investment in other productive sectors of the economy.



India's food security stats

India has been ranked 94 among 107 countries in the **Global Hunger Index (GHI), 2020**. GHI is an annual report published by **Concern Worldwide and Welthungerhilfe**. The index is calculated using four indicators- undernourishment, child wasting, child stunting, and child mortality. India's performance on the indicators are as follows:

1. 14% of India's population is undernourished.
2. Child wasting in India stands at 17.3%.
3. Child stunting rate in India was at 37.4%.
4. Child mortality rate in India stands at 3.7%.

Further, **National Family Health Survey (NFHS-4)** report states that 53% women (15-49 years of age) and 58.4% of children (6-59 months) are anaemic.

However, food insecurity is on the rise due to several reasons like global water crisis, land degradation, climate change, and agricultural diseases. Issues like leakages in the PDS, food wastage due to inadequate storage infrastructure, inefficient targeting of beneficiaries under food distribution programs, and poor last mile reach of government schemes have been a major impediment in achieving food security in India.

To tackle the problem of food security in India, **government provides the following food-based safety nets:**

1. Public Distribution System (as discussed earlier)
2. Integrated Child Development Scheme (ICDS)
3. Mid-Day Meals Program
4. POSHAN Abhiyaan

Integrated Child Development Scheme (ICDS)

ICDS is a Centrally Sponsored Scheme launched in 1975 and implemented by **the Ministry of Women and Child Development**. The scheme aims to provide food, pre-school education, primary healthcare, immunization, health check-up, and referral services to children under 6 years of age and their mothers.

In addition to fighting malnutrition and ill-health, the programme is also intended to combat gender inequality by providing girls the same resources as boys. Tenth five-year plan linked ICDS to Anganwadi centers established mainly in rural areas and staffed with frontline workers. This widespread network of ICDS has an important role to play in combating malnutrition especially for children of weaker groups.

However, a 2005 study found that ICDS was not particularly effective in reducing malnutrition, largely because of implementation problems and because the poorest states had received least coverage and funding. Also, though it has widespread coverage, operational gaps meant that service delivery is not consistent in quality and quantity across the country.

Mid-Day Meals (MDM) Scheme

The MDM scheme is a centrally sponsored school meal program in India designed to better the nutritional standing of school-age children nationwide. It is implemented by the **Ministry of Human Resources and Development**.

The program supplies free lunches on working days for children in **primary and upper primary classes (up to class VIII)** in government, government-aided, local body, Education Guarantee Scheme, and alternate innovative education centers, Madrasa and Maqtabas supported under Sarva Shiksha Abhiyaan, and National Child Labor Project schools run by Ministry of Labor. For primary students, 300 calories and 8-12 grams of protein and for upper primary students, 700 calories and 20 grams of protein has been kept as a norm.

MDM scheme aims to ensure the nutritional status as well as class attendance of poor children. However, the **scheme has failed to meet its end in various regards**.

1. Overall impact of MDM has been limited due to meagre allocation of resources and faulty policy designs.
2. Nutrition deficient meals are being served at most of the schools.
3. Due to nutrition deficient food being served, children are facing the problem of hidden hunger.
4. Corruption in MDM scheme is one of the main reasons of its failure.

- MDM is falling prey to private contractors as per a report prepared by Supreme Court appointed food commissioners.

POSHAN Abhiyaan

POSHAN Abhiyaan or National Nutrition Mission (NNM) is Government of India’s flagship programme, implemented by the **Ministry of Women and Child Development** to improve the nutritional outcomes for children, pregnant women and lactating mothers. For implementation of POSHAN Abhiyaan, the **four points/pillars of the mission are:**

- Inter-sectoral convergence for better service delivery.
- Use of technology (ICT) for real time growth monitoring and tracking of women and children.
- Intensified health and nutrition services for the first 1000 days.
- Jan Andolan or people’s movement around malnutrition.

Targets under POSHAN Abhiyaan are to reduce stunting, undernutrition, low birth weight, and anemia by 2%, 2%, 2%, and 3% respectively by 2022. To achieve this target, half of the funding will be sourced from multilateral institutions like the World Bank.

To oversee the implementation of POSHAN Abhiyaan, National Council on India’s Nutritional Challenges has been constituted under the chairmanship of Vice-Chairman of NITI Aayog.

4.3 STORAGE AND TRANSPORT OF AGRICULTURAL PRODUCE

It has been estimated that about 65% of the total produce is held by the farmers for their self-consumption while the remaining produce is supplied to the central pool. The procurement agency collects the quantity deposited to the central pool by the farmer and transports the same to the FCI or nominated warehouse. Often, the stock is stored in warehouses for more than its shelf-life due to want of off-take of stock by allottees like Targeted Public Distribution system (TPDS) and flour mill owners.

4.3.1 STORAGE OF PRODUCE

Storage is an important marketing function, which involves holding and preserving goods from the time they are produced until they are needed for consumption. Having a **sound storage infrastructure is important** for the following reasons:

- Storage protects the quality of perishable and semi-perishable products from deterioration.
- Farmers can deposit his/her produce in the warehouses when there is a price crash for food items and sell his/her produce at a later date when there is a price rise.
- The storage of goods, from the time of production to the time of consumption, ensures a continuous flow of goods in the market.
- It helps in stabilization of prices by adjusting demand and supply.
- Some of the goods have a seasonal demand. To cope with this demand, production on a continuous basis and storage becomes important.
- Storage provides employment and income through price advantages.
- Construction of storage infrastructure brings in private investment in the agricultural sector.
- Food processing industries require raw food to be stored, marketed, or preserved for consumption later. Hence, developing cold chain infrastructure will give impetus to the food processing industries.

However, the **storage mechanism in India faces certain major challenges:**

1. During peak procurement seasons, due to want of adequate storage facilities, stocks are simply dumped on open spaces where even plinth is not available. Much of these stock gets damaged because of seepage of water from the ground in the absence of proper plinth or height of ground or due to floods and rains.
2. Utter **disregard to safe and scientific storage practices** and poor condition of storage facilities have resulted in excessive damage to food grains in the central pool maintained by state government agencies in various states of India.
3. Despite storage constraints in FCI, the **utilization of existing storage capacity** in various states/UTs was less than 75% in majority of the months during the period 2011-12 to 2016-17.

In order to boost the storage infrastructure, following steps could be undertaken:

1. Storage infrastructure could be built by **encouraging private players to invest** in this sector. **Public-Private Partnership (PPP)** models could be implemented in this regard.
2. Proper plinths should be constructed in **vacant government lands** which can be used for temporary storage of food grains during peak procurement seasons.
3. **Adequate manpower and supervision** are required for scientific and safe storage in warehouses.
4. **Non-adherence of safe and scientific storage methods** should be dealt with an iron hand and the strictest of punishment is to be enforced and accountability fixed.
5. FCI should engage in **open market sale of excess foodgrains** beyond the storage capacity to avoid wastage.

4.3.2 TRANSPORTATION OF PRODUCE

Transportation is considered to be an important aspect in improving agricultural efficiency. It enhances quality of life of the people, creates market for agricultural produce, facilitates interactions among geographic and economic regions and opens up new areas to economic focus. Properly managed transport is efficient in delivering farm resources and harvested crops as fast as possible.

In short, transport enables agriculture and emboldens farmers to invest more and increase production. Without this transport system, large quantities of this painstakingly farmed produce would be laid to waste. Many farmers are cash-strapped and would like to dispose of the produce at the earliest. This means that even if the harvest is plenty, the farmer can still be left in the lurch if the product cannot be reached beyond the boundaries of his town. His produce also needs to reach the consumer at a reasonable price and within reasonable time.

Keeping transports low helps the farmers earn a margin, as well as make it affordable for the consumers. Also, if the transport costs are low, then not only domestic marketing, but the potential for agricultural exports will also increase.

Government announced the following measures for improving agricultural transport system in India:

1. **Kisan Rail:** Trains with refrigerated coaches are provided to improve national cold supply chain for perishables, milk, meat, and fish.

2. **Krishi Udaan:** Ministry of Civil Aviation will permit new flights on international and national routes to transport agricultural cargo. This will immensely help improve value realization (on agricultural products), especially in the north-east and tribal districts.

4.4 AGRICULTURAL MARKETING

Agricultural marketing covers the services involved in moving an agricultural product from the farm to the consumer. These services involve planning, organizing, directing, and handling of agricultural produce in a way so as to satisfy farmers, intermediaries, and consumers.

Agricultural marketing has the following significance:

1. It is aimed at providing remunerative prices to the farmers.
2. It ensures supply of food of required quality at reasonable prices to the consumers.
3. An efficient marketing system minimizes costs and maximizes benefits to all sections of the society.

4.4.1 AGRICULTURE PRODUCE MARKETING COMMITTEES (APMC)

APMC is a statutory market committee constituted by the state government in respect of trade in certified notified agricultural or livestock or horticultural products, under the APMC Act issued by that state government. APMC law states that first sale of agricultural produce can occur only at the mandis of Agricultural Produce Market Committees.

APMC Act was enacted with the following intentions:

1. Providing market-led extension services to the farmers.
2. Ensuring transparency in the pricing systems and transactions taking place in the market area.
3. Ensuring that farmers are not exploited by the money lenders who compel farmers to sell their produce at the farm gate for an extremely low price.
4. Ensuring payment for agricultural produce sold by the farmer on the same day.
5. Promoting agricultural processing activities.

However, **there are some major issues with the functioning of APMCs:**

1. APMCs suffer from **poor infrastructure** like lack of cold-storage and transport facilities. As a result, much of the perishable commodities gets wasted.
2. APMC mandis charge **multiple entry and exit fees** as well as licensing fees.
3. Markets are **over-regulated** leading to a lot of corruption and exploitation of farmers.
4. **Rise of intermediaries** in the APMC mandis who often form cartels, manipulate prices and deprive the farmers of remunerative prices.
5. **Hoarding of agricultural produce** by the APMC middlemen leads to an artificial shortage of food supply in the open market, thereby driving up the food inflation.
6. Under APMC regulation, no exporter or processor can directly buy agricultural produce from the farmers. This **discourages processing and agri-exports**.
7. Since only the state governments can set up APMC market as provided under the legislation, it **prevents the private sector from setting up markets** and investing in marketing infrastructure.

8. APMC office bearers also **lack corporate skills** for vertical integration with food processing industries.

Model APMC Act, 2003

Some of the **salient features of the Model APMC Act, 2003** include:

1. Facilitating contract farming model.
2. Special market for perishables.
3. Allowing farmers and private persons to set up their own markets.
4. Relaxation of licensing norms.
5. Single market fee.
6. APMC revenues to be used for improving market infrastructure.

Model Agricultural Produce and Livestock Marketing (Promotion & Facilitation) Act, 2017

Major provisions of the Draft Model Act are:

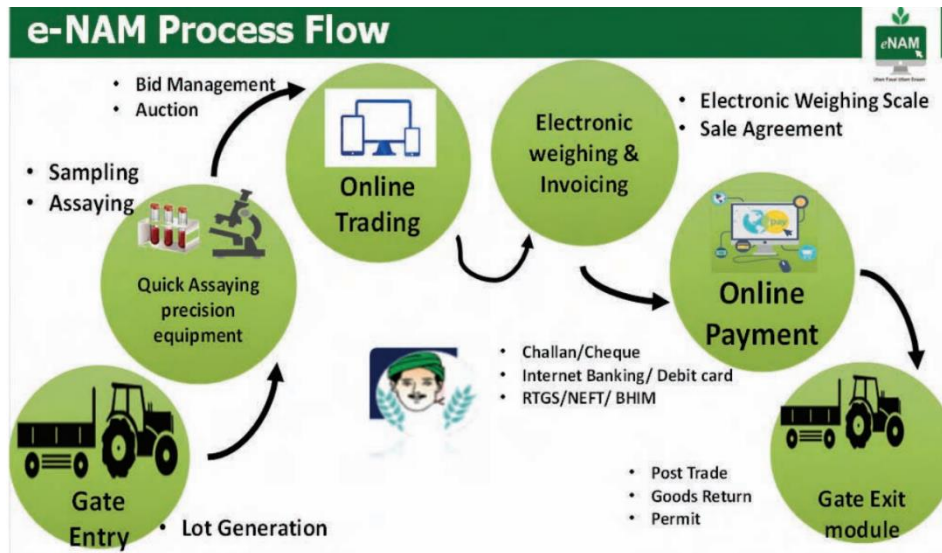
1. It specifies a single license for trading within the State and at the National level.
2. Traders will be allowed to sell perishables outside existing mandis.
3. Farmers can directly sell their produce to the bulk buyers.
4. The greatest extent of a market fee is not more than 2% (of sale price) for foodgrains and 1% for fruits and vegetables.
5. Warehouses, private market yards, and cold storages would be permitted to act as regulated markets.
6. All regulatory powers will lie with the office of the director of agricultural marketing in the state, who will also issue licenses to traders and new private players.

4.4.2 INTEGRATED SCHEME FOR AGRICULTURAL MARKETING (ISAM)

The Integrated Scheme for Agricultural Marketing has six sub-schemes namely (i) Agricultural Marketing Infrastructure (AMI), (ii) Marketing Research and Information Network (MRIN), (iii) Strengthening of Agmark Grading Facilities (SAGF), (iv) Training, Research and Consultancy through Choudhary Charan Singh National Institute of Agricultural Marketing (NIAM), (v) Agri-business Development through Venture Capital Assistance (VCA) and Project Development Facility, and (vi) National Agriculture Market (e-NAM).

4.4.3 e-NAM (ELECTRONIC NATIONAL AGRICULTURAL MARKETS)

e-NAM is a pan-India electronic trading portal which networks the existing APMC mandis to create a unified national market for agricultural commodities. **Small Farmers Agribusiness Consortium (SFAC)** is the lead agency for implementing e-NAM under the aegis of **Ministry of Agriculture and Farmers' Welfare, Government of India**.



SFAC is an autonomous society promoted by the Ministry of Agriculture, Cooperation and Farmers' Welfare, Government of India. It was registered under Societies Registration Act XXI of 1860 on 18th January 1994.

e-NAM offers several advantages to various stakeholders:

- 1. Farmers:** They can sell their products without the interference of any brokers or middlemen thereby making competitive returns out of their investment.
- 2. Traders:** Traders will be able to do secondary trading from one APMC to another one anywhere in India. Local traders can get access to the larger national market for secondary trading.
- 3. Buyers, processors, and exporters:** They will be able to source commodities from any mandi in India thereby reducing their inter-mediation cost. Their physical presence and dependence on intermediaries will not be needed.
- 4. Consumers:** e-NAM will increase the number of traders and the competition among them increases. This translates into stable prices and availability to the consumers.
- 5. Mandis:**
 1. There will be a reduction in bookkeeping and reporting system as it will be generated automatically.
 2. Monitoring and regulation of traders and commission agents becomes easy.
 3. Transparency in the process eliminates the scope of manipulation of tendering/auctioning process.
 4. It will reduce the manpower requirements as the tendering/auctioning process is carried out electronically.
 5. It eliminates information asymmetry as all the activities of an APMC can be known directly from the website.
- 6. Others:** e-NAM aims to improve the marketing aspect of the agricultural sector. With one license for the entire state and single point levy, an entire state becomes a market and the

market fragmentation within the same state gets abolished. It will improve the supply chain of commodities and reduce wastages.

Problems facing agricultural marketing in India and its solutions

Some of the problems being faced by the agricultural marketing sector in India in general includes:

1. Warehousing facilities for storage of agricultural produce is inadequate.
2. **Poor transportation facilities** like unusable roads and lack of connectivity makes it difficult to take agriculture produce to the markets.
3. In the absence of proper agricultural markets, most farmers are forced to sell their output to local moneylenders at a much cheaper price.
4. In the **absence of market intelligence**, farmers are unable to assess the correct price of their produce based on the demand-supply equations.
5. APMC mandis face their own set of challenges like poor storage facilities, intermediaries charge their own commissions from farmers, and corruption.
6. There is a complete lack of awareness amongst the farming communities regarding the **commodity trading**.

To solve these above stated problems, government is implementing steps like e-NAM, and contract farming. Government of India also drafted a Model law- Agricultural Produce and Livestock Marketing (Promotion and Facilitating) Act, 2017. Apart from these, **NITI Aayog also recommended certain reforms** like:

1. Take fruits and vegetables out of the APMC Act.
2. Set up markets in the private sector (private mandis) and direct marketing to reduce the dependence of farmers on the intermediaries.
3. Adopt e-trading, single trading license and a single point of levy of market fee.

Government also needs to focus on strengthening the storage and transport infrastructure to reduce the costs associated with agricultural marketing. Information asymmetry needs to be addressed by promoting agricultural marketing research and disseminating market intelligence to the farmers so that they could appropriately price their produce based on the market demands.

Futures Contract/Commodity Trading

Futures Contract is simply an agreement to purchase or sell a specified quantity of a particular agricultural commodity at predetermined prices on a future date. Benefits of this type of an arrangement are:

1. Commodity trading helps to **stabilize prices of agricultural products** by acting as a link between future and spot prices. Future and spot prices have a direct relationship, and hedging can mitigate the risks associated with unprecedented price fluctuations. While seasonal variations of prices are minimized, farmers/producers benefit because of stable prices.
2. Commodity trading in agro products helps to develop **efficient hedging and speculation strategies**. For instance, if there is a marked change in future prices, because of existing spot prices, an efficient hedging strategy can be made. On the other hand, if changes in future

prices impact existing spot prices, an efficient speculation strategy can be formulated. Thus, on the basis of current market trends, it allows for finding future prices.

3. Trading in agricultural commodities can help arrive at an **accurate, market-oriented price of agricultural products**. This is of key importance as, at times, the Minimum Support Price (MSP) fixed by the government and the wholesale prices fixed by the farmers are not in sync with the existing market patterns.

Some of the platforms for agricultural commodity trading are- AGRIDEX launched by National Commodity and Derivatives Exchange (NCDEX) and BEAM (BSE E-Agricultural Markets Ltd.) launched by Bombay Stock Exchange (BSE).

4.4.4 GRAMIN AGRICULTURAL MARKETS (GrAMs)

GrAM is a village level market in India. There are 22,000 such rural agricultural markets which helps farmers in selling their produce locally. Farmers can directly sell from GrAMs instead of transporting their produce to the APMC mandis. These local markets, GrAMs, will be linked with the electronic farmer marketplace, e-NAMs (electronic National Agricultural Markets) to sell their produce nationally.

4.4.5 FARM LAWS 2020

Farm laws were introduced due to the following reasons:

1. Agriculture in India has become a non-remunerative profession.
2. APMC suffers from a multitude of problems like cartelization, high commission charges, and limited choice to the farmers for sale of their produce.

4.4.5.1 THE FARMERS' PRODUCE TRADE AND COMMERCE (PROMOTION AND FACILITATION) ACT, 2020

Key features of the Act include:

1. The Act allows **intra-state and inter-state trade of farmers' produce** outside:
 1. The physical premises of market yards run by market committees formed under the state APMC Acts.
 2. Other markets notified under the state APMC Acts.
2. It permits **electronic trading** of scheduled farmers' produce in the specified trade area.
3. The Act prohibits state governments from levying any market fee, cess or levy on farmers, traders, and electronic trading platforms for trade of farmers' produce conducted in an **'outside trade area'**.

The Act will promote an integrated market and reduce the role of intermediaries. However, **there are certain potential issues with the Act:**

1. State governments will **lose mandi tax**, which is a major source of revenue for states like Punjab and Haryana.
2. The Act creates an artificial distinction between **"market areas"** (regulated by the mandi system state government) and **"trade areas"** (now under central governments). This risks the problem of dual regulatory market. Further, the unregulated "trade areas" will have no oversight and the

government will have no information and intelligence about who the players are, who is transacting with who for what quantities and at what prices.

3. Electronic trading like in e-NAM is riding on top of physical mandi structure in the country, not as parallel system. If the mandis are destroyed without much trading, it could potentially lead to the **collapse of the APMC system** and initiatives like e-NAM.

4.4.5.2 THE FARMERS (EMPOWERMENT AND PROTECTION) AGREEMENT ON PRICE ASSURANCES AND FARM SERVICES ACT, 2020

Key features of the Act include:

1. The Act provides for a farming agreement between a farmer and a buyer prior to the production or rearing of any farm produce. It will **promote contract farming**, reduce the risk of market unpredictability for the farmers and attract private investment in agriculture.
2. The **price of farming produce** should be mentioned in the agreement. Getting an assured and remunerative price as mentioned in the agreement will enable farmers to buy improved inputs like seeds, fertilizers, and pesticides, and better technology.
3. The Act provides for an **effective dispute resolution mechanism** for settlement of disputes.
4. The Act will also reduce the cost of marketing for the farmers as after signing the contract, farmers will not have to seek out traders. The purchasing consumer will pick up the produce directly from the farm.

Contract farming

Contract farming can be defined as agricultural production carried out according to an agreement between a buyer and farmer, which establishes conditions for the production and marketing of a farm product or products. Typically, the farmer agrees to provide agreed quantities of a specific agricultural product.

Contract farming offers several advantages like:

1. Makes small-scale farming competitive- small farmers can access technology, credit, marketing channels, and information while lowering transaction costs.
2. Assured market for their produce at their doorsteps, reducing marketing and transaction costs.
3. It reduces the risk of production, price, and marketing costs.
4. Contract farming can open up new markets which would otherwise be unavailable to small farmers.
5. It also ensures higher production of better quality, financial support in cash and/or kind and technical guidance to the farmers.
6. In the case of agri-processing level, it ensures a consistent supply of agricultural produce with quality, at the right time, and lesser cost.

However, there are **challenges associated with contract farming** as well:

1. Contract farming arrangements are often criticized for being biased in favor of firms or large farmers while exploiting the poor bargaining power of small farmers.

2. Problems faced by growers like undue quality cut on produce by firms, delayed deliveries at the factory, delayed payments, low price, and pest attack on the contract crop which raised the cost of production.
3. Contract agreements are often verbal or informal, and even written contracts often do not provide the legal protection in India that may be observed in other countries. Lack of enforceability of contractual provisions can result in the breach of contracts by either party.
4. Single buyer and multiple sellers lead to monopsony.
5. Gender discrimination is prominent in contract farming with women having less access to contract farming than men.

However, **there are certain potential issues with the Act:**

1. Farmers fear that this Act would pave the way for **dismantling of the MSP** and leave the farming community at the “mercy” of big corporates.
2. The Act does not prescribe the mechanism for price fixation or a methodology for regulatory oversight.
3. The Act does not require companies to have a written contract with the farmer, making it difficult to prove terms of the contract.
4. The dispute resolution mechanism also has its flaws. In case of disputes, **the district administration** has been entrusted with the responsibility to resolve the same, but it may not be well equipped or lack the requisite skills to settle disputes.

4.4.5.3 THE ESSENTIAL COMMODITIES (AMMENDMENT) ACT, 2020

Key features of the Act include:

1. The Essential Commodities Act, 1955 empowers the central government to designate certain commodities (such as food items, fertilizers, and petroleum products) as essential commodities. The central government may regulate or prohibit the production, supply, distribution, trade, and commerce of such essential commodities. The Amendment Act provides that the central government may regulate the supply of certain food items including cereals, pulses, potatoes, onions, edible oilseeds, and oils, only under extraordinary circumstances. These include: (i) war, (ii) famine, (iii) extraordinary price rise, and (iv) natural calamity or grave nature.
2. The Act requires that imposition of any stock limit on agricultural produce must be based on price rise. The stock limit must be imposed only if there is:
 - (i) a 100% increase in the retail price of horticultural produce, and
 - (ii) a 50% increase in the retail price of non-perishable agricultural food items. The increase in price will be calculated over the price prevailing immediately preceding 12 months, or the average retail price of the last 5 years, whichever is lower.

The Act has certain intended benefits like:

1. Earlier, government had the power to impose restrictions on hoarding of food commodities and could seize any excess stocks maintained by the trader. This often resulted in harassment of businessmen and traders and rent seeking behavior. Now, with government regulating supply of certain essential commodities only under extraordinary circumstances, there would be no such undue interference.

2. The earlier stock limit conditions imposed through the law were hindering investment in agricultural infrastructure. The latest amendment will **boost investment in the agriculture sector** and create more storage capacities to reduce post-harvest losses of crops.
3. Exempting selected commodities from Essential Commodities Act (ECA) will improve the **marketability of crop for growers and ensure price stability and raise farm incomes.**

However, **certain apprehensions expressed with the Act** are:

1. It would effectively **legalize hoarding** which in turn could lead to artificial food shortage in the open market and result in food inflation.
2. Invisibility of stocks through this Act is a dangerous situation to walk into, which will create **serious food supply problems during extraordinary circumstances.** The government will not be able to even verify on the stock limits as it will not have any information on who the players are, and the levels of stocks are not clear.

4.4.6 AGRI-EXPORTS

Since 1991 LPG reforms, India has constantly remained a net exporter of agricultural products. **Rice** has the greatest share in our export basket, followed by oil meals and sugar (as per 2018-19 data).

Agricultural exports bring crucial forex earning for India. Also, farmers are able to reap the benefits of higher prices of agricultural products in the international markets, thereby raising their farm incomes. Through export of agricultural commodities, Indian farmers get an opportunity to take part in the global supply chains. Further, exports also promote value addition to agricultural products due to a huge demand of processed foods in the international market. Forward and backward linkages are also created in the agricultural sector.

To tap the huge international market for our agricultural produce, the Commerce Ministry released the **Agri Export Policy, 2018.** Some of the targets to be achieved under the policy are as follows:

1. To double the agricultural exports from present \$30 billion to \$60 billion by 2022 and reach \$100 billion in the next few years.
2. To diversify our export basket by including items like wild herbs, aromatic oils, confectionary and processed foods, etc.
3. To diversify our export destinations by including more countries in our export list.
4. To boost agricultural value-added exports like jams etc.
5. To focus on branding and marketing of Indian ethnic products in overseas market.
6. Encourage private investment in areas like cold chain storage.
7. To help exporters with Sanitary and Phyto-Sanitary (SPS) issues so that their products are not banned in countries like U.S.A on allegations of not meeting their health safety standards.

High Level Expert Group (HLEG) on Agricultural Exports set up by the 15th Finance Commission recommended creating **state level agri-export plans** and focusing on value addition in order to enhance exports.

Foreign Direct Investment (FDI) Policy in Agriculture

100% FDI has been allowed in development and production of seeds and planting material. In addition, 100% FDI is allowed for floriculture, horticulture and cultivation of vegetables and

mushrooms under controlled conditions. Also, 100% FDI is allowed in animal husbandry, pisciculture, aquaculture, and services related to allied and agro sectors. Similarly, 100% FDI is allowed in the plantation sector namely tea, coffee, rubber, cardamom, palm oil tree, and olive oil tree.

Year	Amount of FDI Inflows	
	(In Rs. Crore)	(In US\$ Million)
2012-13	1392	257
2013-14	845	140
2014-15	796	130
2015-16	673	103
2016-17	618	92
2017-18	821.3	127.4
2018-19	664.7	93.9
2019-20 (April-September)	677.81	97.20

Source: Department for Promotion of Industry and Internal Trade (DPIIT)

FDI Inflows in the Agriculture Sector in India

4.5 INCOME SUPPORT TO FARMERS

NABARD's **All India Rural Financial Inclusion Survey** made the following observations:

1. Around 10 crore rural households out of 21 crore households are engaged in agriculture. However, the monthly average agricultural household income was a mere **Rs 8,931 in 2016-17**.
2. Even for the so-called agricultural households, just over 43% of their average income comes from cultivation of crops and rearing of animals.
3. 41% of the rural households are indebted, of which majority are agricultural households (43%).
4. Only 26% of the agricultural households out of the total rural households have any kind of insurance.
5. Only around 53% of agricultural households report savings in a financial institution indicating low levels of financial inclusion.

The above findings conclude that farm income levels are not satisfactory, making agriculture a non-profitable enterprise. A sound income level gives a sense of security to the farmers and encourages him to take risks. Having a high income promotes farmers to invest more in agriculture by adopting new technologies and purchasing better inputs (high quality seeds and fertilizers), which effectively increases agricultural productivity. A fair level of farm income also leads to socio-economic development of farming households, reduces rural indebtedness and minimizes farmer suicides.

4.5.1 PM KISAN

PM KISAN is a Central Sector Scheme implemented by the Agriculture Ministry in which all farmers, irrespective of farm size, will get up to Rs 6,000 per year as minimum income support. The amount will

be paid to each eligible farmer in three installments and will be deposited directly to their bank accounts. Aadhar is compulsory for farmers for verifying his identity, although it has been kept optional for the 1st and 2nd installment.

The **objectives of PM KISAN** are as follows:

1. To augment the income of the Small and Marginal Farmers (SMFs).
2. To supplement the financial needs of SMFs in procuring various inputs to ensure proper crop health and appropriate yields, commensurate with the anticipated farm income at the end of each crop cycle.
3. To protect SMFs from falling into the clutches of moneylenders for meeting such expenses and ensure their continuance in farming activities.

However, **there are some issues with the scheme** which needs to be addresses:

1. Rs 6000 may **not be sufficient to cover the rising cost of inputs** like seeds, fertilizers, labor wages, etc.
2. The scheme excludes **landless farmers** whose name is not in the land records of the State/UTs.
3. The central scheme **overlaps with certain state government initiatives** like Telangana's Rythu Bandhu scheme. Also, some of the state initiatives like Odisha's KALIA scheme offers wider coverage by including even the landless farmers/tenants.
4. There are possibilities that the income support being provided to the farmers under PM KISAN may be used on **non-agricultural/non-productive activities** like alcoholism.
5. The income support would require **huge budgetary allocations** and may strain center's finances.

4.5.2 PM KISAN MAAN DHAN YOJANA

Government has launched the PM Kisan Maan Dhan Yojana (PM-KMY) with a view to provide **social security to Small and Marginal Farmers (SMFs)** in their old age when they have no means of livelihood and minimal or no savings to take care of their expenses.

Under the scheme, a monthly fixed pension of Rs 3000 is provided to the small and marginal farmers, subject to certain exclusion criteria, on attaining the age of 60 years. It is a voluntary and contributory pension scheme. The eligible farmer is required to contribute to a Pension Fund between Rs. 55 and Rs. 200 per month depending on the entry age. The Central Government contributes an equal amount to the Pension Fund.

Small and Marginal Farmers (a farmer who owns cultivable land up to 2 hectares as per the land records of the state) in the age bracket 18-40 years are eligible to join the pension scheme. Farmers who are **not eligible** to join the scheme includes:

1. Small/Marginal farmers who joined PM Shram Yogi Maan Dhan Yojana, National Pension Scheme, EPFO or any other government run pension scheme.
2. Farmers owning more than 2 hectares of land.
3. All persons who have paid Income Tax in the last assessment year.

4.5.3 RAISING FARM INCOMES

Doubling farmers income by 2022

The government launched an Inter-ministerial Committee in April 2016 to examine issues relating to “Doubling of Farmers Income (DFI)” and recommend strategies to achieve the same. The DFI strategy as recommended by the committee include **seven sources** of income growth:

1. Improvement in **crop productivity**.
2. Improvement in **livestock productivity**.
3. **Resource use efficiency** or savings in the cost of production.
4. Increase in **cropping intensity**.
5. **Diversification** towards high value crops.
6. Improvement in **real prices** received by the farmers.
7. Shift from farm to **non-farm occupations**.

Farmer Producer Organization (FPO)

A Producer Organization (PO) is a legal entity (company, cooperative society, etc.) formed by primary producers like farmers, milk producers, fishermen, weavers, and rural artisans. FPO is one type of PO where members are farmers.

Through the formation of FPOs, the farmers will have better collective strength for better access to quality input, technology, credit, and better marketing through economies of scale **for better realization of income**. Also, FPOs increase the bargaining power of farmers as it allows members to negotiate as a group and can help farmers in both inputs and outputs.

Currently, there are over 5,000 FPOs in the country. 20% of these are struggling to be viable and 50% are in mobilization stage only. **Small Farmers’ Agri-Business Consortium (SFAC)** in its recent strategy paper estimated that only 30% of the FPOs have viable operations.

Some of the challenges faced by FPOs in India include difficulty in mobilizing farmers, improper management, limited membership, inability access to credit, etc. SFAC in its strategy paper also lists out a few challenges like farmer’s limited understanding of business, the need for incubation and handholding as well as constraints in raising equity capital. Another major issue is that the farmer producer companies do not have the technical and managerial expertise to carry on their requisite work, including forward-backward linkages, best agricultural practices, seed production, value addition, branding, etc. to make their business operation sustainable and more profitable for all stakeholders.

In order to address these challenges, Ministry of Agriculture and Farmers Welfare launched a Central Sector Scheme, “**Formation and Promotion of Farmer Producer Organizations (FPOs)**”. **Objectives of the scheme are as follows:**

1. 10,000 FPOs will be formed in five years period from 2019-20 to 2023-24.
2. Handholding support to each FPO would be continued for 5 years from its year of inception for which support will continue till 2027-28.
3. Beneficiaries of the scheme are small and marginal farmers.

4. Cluster based business organizations will be formed at cluster/state level for implementing the scheme.
5. At least 15% of the targeted FPOs would be in aspirational districts with at least one FPO in each block of aspirational districts of the country.
6. FPOs will be promoted under “One District One Product” cluster.

FPOs can be further strengthened through various policy and structural reforms, including technology support, financial support through customized services and loan products and marketing support in various markets available.

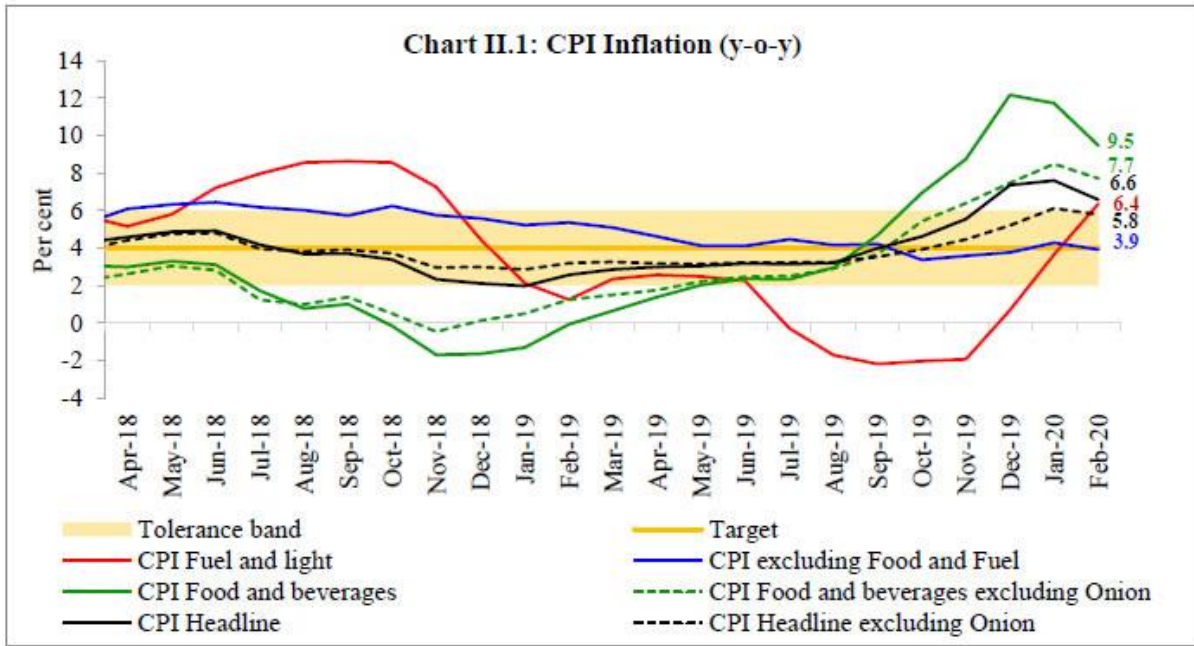
National Policy for Farmers, 2007

The **broad areas of its coverage** include:

1. Focus will be on **economic well-being of the farmers** in addition to production and productivity.
2. **Asset reforms** to ensure that a farmer household in villages either possesses or has access to a productive asset or marketable skill.
3. **Water Use Efficiency** for maximizing yield and income per unit of irrigation water in all crop production programmes.
4. **New technologies** like biotechnology, information and communication technology (ICT), renewable energy technology, space applications and nanotechnology would be encouraged for improving productivity per unit of land and water on a sustainable basis.
5. **National Agricultural Bio-security System** would be established to organize and coordinate agricultural biosecurity programme.
6. Quality seeds, disease free planting material and soil health enhancement hold the key to raising small farm productivity. Accordingly, every farmer is to be issued with a **soil health passbook** containing integrated information on farm soils with corresponding advisories.
7. **Adequate support services** like creches, child-care centers and adequate nutrition needed by women working in fields would be funded.
8. The **financial services would be galvanized** for timely, adequate and easy reach to the farmers at reasonable interest rates.
9. **Gyan Chaupals** at village level with the help of ICT and farm schools in the fields of outstanding farmers to promote farmer to farmer learning would be set up through the State Government for strengthening extension services.
10. Necessary steps would be taken to put in place an appropriate **social security scheme** for farmers.
11. Minimum Support Price (MSP) mechanism to be implemented effectively across the country so as to **ensure remunerative prices** for agricultural produce.
12. **Food security basket is to be enlarged** to include nutritious millets such as bajra, jowar, ragi, etc. mostly grown in dryland farming areas.

4.6 AGRICULTURAL PRICE VOLATILITY

Prices of agricultural commodities like onions, tomatoes, and pulses have seen huge price fluctuations in the recent past. For e.g., onion prices peaked in mid-October 2018 in parts of the country, bringing to the fore the recurring price volatility of this vegetable which the country witnesses every season.



Sources: National Statistical Office (NSO); and RBI staff estimates.

The key reasons for severe and frequent price shocks are attributed by agriculture experts to production fluctuations and changes in the nature of the demand.

4.6.1 FOOD INFLATION

The condition of an increase in the wholesale price index of a necessary food item relative to the general index or the consumer price index (CPI) is referred to as food inflation. Food inflation in India averaged 6.07% from 2012 until 2021, reaching an all-time high of 14.72% in November of 2013 and a record low of -2.65% in December of 2018.



Food Inflation

Source-Ministry of Statistics and Programme Implementation

Some of the reasons for food inflation include:

1. **Shortage of food supply:** Food supply shortage has been a result of various factors like:
 1. Excessive use of pesticides and fertilizers have led to a **decline in soil fertility**.
 2. **Incidents of pests and diseases** have increased. For e.g., the desert locust attack wiped out crops spread over 5,00,000 hectares of land in Rajasthan.
 3. As the government continuously hikes the **MSP on rice and wheat**, more and more farmers shift from vegetables/pulses to cereal production. This leads to a decline in the production of vegetables and pulses and pushes their prices up.
 4. There is a huge price difference between wholesale and retail prices. This is often due to poor functioning of **APMCs mandis** (presence of intermediaries, license fees, etc.).
 5. **Uncertain monsoonal patterns** disrupt the supply chains. Late arrival of monsoon delays the sowing period while prolonged and heavy rains destroy the standing crops.
 6. Certain crops like pulses are protein-rich and leguminous in nature, so they are more susceptible to pest attack. Also, when they are stored in godowns, they are highly prone to fungal attack. As a result, most of the crops are destroyed which often leads to **supply shortages**.
 7. **Poor transportation facilities** also result in a delay in transportation of produce from farms to the retail market.
 8. **Cases of hoarding** have been reported with respect to agricultural commodities which in turn leads to artificial inflation.
 9. **Global warming** has led to a decline in the general productivity of agriculture.
2. **High demand:** As more and more Indians move into the middle-income wage bracket, the demand for high value crops like rice, wheat, and sugarcane increases. On the other hand, the production is not sufficient to meet the rising demands of the growing population. This also leads to food inflation.

Cobweb Cycle

Cobweb cycle refers to fluctuations occurring in markets in which the quantity supplied by producers depends on prices in previous production periods. It occurs most commonly in agriculture, because the decision of what to produce in the coming year is often based on the results of the previous year. For e.g., if corn prices are particularly high in a given year, more farmers will choose to plant corn the next year to take advantage of the high price. This increased supply, however, will lead to lower prices.

To keep a tab on food inflations, government has taken several measures:

1. **Minimum Export Price (MEP):** MEP is the price below which commodities cannot be exported from India. When there is inflation in the market, government will increase the minimum export prices so as to discourage exports from India. This will lead to a higher availability of the product in India and control its price.
2. **Open Market Sale Scheme (OMSS):** Food Corporation of India (FCI), a statutory body under the Commerce Ministry, sells grains in the open market during food inflation to increase supply and check price rise.

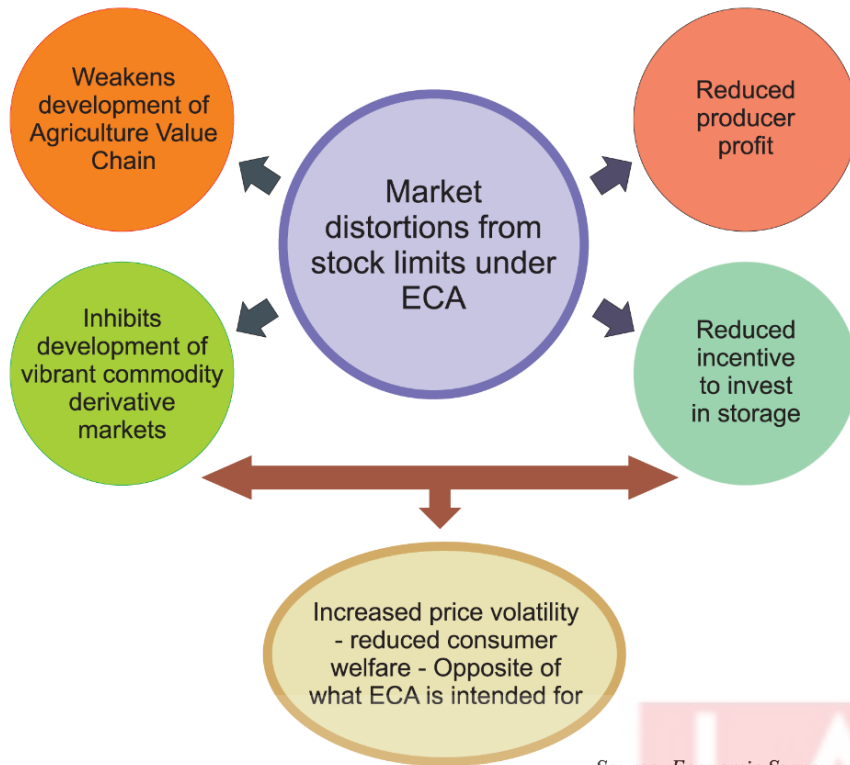
3. **Price Stabilization Fund (PSF):** PSF was established under the Department of Agriculture, Cooperation and Farmers Welfare to regulate the cost volatility of essential agricultural commodities such as **onions, potatoes, and pulses**. The sum in the fund is usually used for activities aimed at bringing down/up the high/low prices say, for example, acquisition of certain goods and distribution of the same as and when appropriate so that the costs remain within a range.
4. **Operation Greens:** The scheme has been launched by the Food Processing Ministry with NAFED as the nodal agency 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. Ministry of Food Processing Industries extended the Operation Greens Scheme from **TOP to all fruits and vegetables (TOTAL)** on a pilot basis as part of Atmanirbhar Bharat Abhiyan.
5. **Agriculture Infrastructure Fund (AIF):** AIF is a central sector scheme aimed at providing medium-long term debt financing facility for investment in viable projects for post-harvest management infrastructure and community farming assets. Cold stores and chains, warehouses, silos, etc. will be set up. **Features of the AIF** are as follows:
 1. Financial support of Rs. 1 lakh will be provided by the banks as loans to Primary Agricultural Credit Societies (PACS), Farmer Producer Organizations (FPOs), Self-Help Groups (SHGs), etc.
 2. Loans will have an interest subvention of 3% per annum up to a limit of Rs. 2 crores.
 3. A credit guarantee coverage will be available for eligible borrowers from the scheme under CGTMSE (Credit Guarantee Fund Trust for Micro and Small Enterprises) for a loan up to Rs. 2 crores.
 4. An online Management Information System (MIS) platform will manage and monitor the fund.

The agricultural infrastructure constructed under the AIF scheme will reduce post-harvest losses and minimize wastage. This will ensure that adequate supply of agricultural commodities is maintained to keep inflation under control.

6. **Essential Commodities Act (ECA), 1955:** The Essential Commodities Act has been used by the government to regulate the production, supply, and distribution of a whole host of commodities that it declares 'essential' (e.g., foodgrains, pulses, oilseeds, jute, fertilizers, seeds, petrol, diesel, kerosene, etc.) to make them available to consumers at a fair price. This act was modified by the **Essential Commodities (Amendment) Act, 2020** as a part of the 2020 Indian farm reforms.

ECA not only keeps food inflation under check but also checks negative market tendencies like black marketing and hoarding. However, Economic Survey 2020 presented a critical evaluation of the ECA.

Agricultural Market Distortions due to ECA



Source- Economic Survey

Observations made by the Economic Survey 2020 regarding ECA, 1955 are as follows:

1. The Act does not distinguish between **firms that genuinely need to hold stocks** owing to the nature of their operations and firms that might speculatively hold stocks.
2. The imposition of the Act has been **ineffective in controlling the price volatility**, as is evident by the examples of pulses (in 2006-Q3 and 2009-Q1) and onion (Sep-2019), where prices spiked despite the imposition of ECA.
3. The increasing wedge between wholesale and retail prices of essential commodities further reinforces that ECA **reduces the welfare of consumers**.
4. In the long run, ECA **disincentivizes development of storage infrastructure** thereby leading to increased volatility in prices following production/consumption shocks- the opposite of what has been intended.
5. The conviction rate under the Act is merely 2-4%, indicating that raids under ECA may be only leading to harassment of traders.

The Survey suggests following alternatives to ECA for stabilization of prices:

1. Strengthening of Price Stabilization Fund (PSF) that was created in 2014-15.
2. Development of an effective forecasting mechanism, stable trade policies and increasing integration of agricultural markets.

4.6.2 FOOD DEFLATION

Food deflation is an opposite trend of inflation and indicates a decline in the price of food items.

Reasons for food deflation in India in the recent times are as follows:

1. **Protectionist policies** followed by countries like U.S.A and European Union (EU) has led to a decline in demand for Indian agricultural products in the international market. As a result, the domestic food supply increases and leads to deflation.
2. Events like demonetization led to **cash shortage** in the hands of the common person. As a result, there were plenty of goods, but people did not have the money to buy, pushing the prices down.
3. Limits on cash transactions and increased fear of being tracked by Income Tax authorities post-demonetization disincentivized hoarding of agricultural goods by traders, resulting in **more supply** of such commodities in the retail market.
4. **RBI's hawkish monetary policy** to keep inflation under control also contributed to some extent to the deflationary trends.

Agricultural price volatility is serious matter of concern for our nutritional security as well as agricultural export competitiveness. Hence, the issue must be tackled on a priority basis.

CHAPTER 5**TECHNOLOGY MISSIONS**

Technology missions focused on technological enhancements for rejuvenating agriculture and its sub-sectors.

5.1 MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE (MIDH)

MIDH is a Centrally Sponsored Scheme for the holistic growth of the horticulture sector covering fruits, vegetables, root and tuber crops, mushroom, spices, flowers, aromatic plants, coconut, cashew, cocoa, and bamboo. Under MIDH, Government of India (GOI) contributes 60% of total outlay for developmental programmes in all states except states in North-East and Himalayas. 40% share is contributed by the State Governments.

In case of North Eastern States and Himalayan States, Government of India contributes 90%. In case of National Horticulture Board (NHB), Coconut Development Board (CDB), Central Institute for Horticulture (CIH), Nagaland and National Level Agencies (NLA), GOI contributes 100%.

MIDH also provides technical advice and administrative support to State Governments/State Horticulture Missions (SHMs) for the Saffron Mission and other horticulture related activities like Vegetable Initiative for Urban Clusters (VIUC) funded by RKVY (Rashtriya Krishi Vikas Yojana)/NMSA (National Mission on Sustainable Agriculture).

MIDH was approved in 2013 and it targeted to achieve a growth rate of 7.2% in horticulture sector in the 12th Five Year Plan. The interventions under MIDH will have a blend of technological adaptation supported with fiscal incentives for attracting farmers as well as entrepreneurs involved in the horticulture sector. It **has subsumed six ongoing schemes:**

1. **National Horticulture Mission (NHM):** NHM's key objective is to develop horticulture to the maximum potential available in the state and to augment production of all horticultural products in the state. Other objectives include:
 1. To provide holistic growth of the horticulture sector through an area-based regionally differentiated strategies.
 2. To enhance horticulture production, improve nutritional security and income support to farm households.
 3. To establish convergence and synergy among multiple on-going and planned programmes for horticulture development.
 4. To promote, develop and disseminate technologies, through a seamless blend of traditional wisdom and modern scientific knowledge.
 5. To create opportunities for employment generation for skilled and unskilled persons, especially unemployed youth.
2. **Horticulture Mission in North-East and Himalayan states (HMNEH):** HMNEH is a part of MIDH scheme, being implemented for overall development of Horticulture in North-East and Himalayan states. The mission covers all North-East states including Sikkim, the Union Territory of Jammu & Kashmir and the two Himalayan states of Uttarakhand and Himachal Pradesh. The mission addresses entire spectrum

of horticulture from production to consumption through backward and forward linkages and targets the small and marginal farmers of North-East and other Himalayan States.

3. **National Bamboo Mission (NBM):** NBM is applied in all states and UTs to address developmental issues of bamboo. It mainly emphasized on propagation and cultivation of bamboo, with limited efforts on processing, product development, and value addition.

Restructured National Bamboo Mission was approved by the Cabinet Committee on Economic Affairs (CCEA). The mission envisages promoting holistic growth of bamboo sector by adopting area-based, regionally differentiated strategy and to increase the area under bamboo cultivation and marketing.

The **restructured NBM strives to achieve the following:**

1. To increase the area under bamboo plantation in non-forest Government and private lands to supplement farm income and contribute towards resilience to climate change.
 2. To improve post-harvest management through establishment of innovative primary processing units, treatment and seasoning plants, primary treatment and seasoning plants, preservation technologies and market infrastructure.
 3. To promote product development at micro, small, and medium levels and feed bigger industry.
 4. To rejuvenate the underdeveloped bamboo sector in India.
 5. To promote skill development, capacity building, and awareness generation for development of bamboo sector.
4. **Coconut Development Board (CDB) Schemes:** CDB schemes is applied in States and UTs producing coconut.
 5. **Central Institute of Horticulture (CIH) Schemes:** The scheme is implemented in the North-Eastern States, with focus on human resources development and capacity building.
 6. **National Horticulture Board (NHB) Scheme:** NHB implements programmes as sub-scheme of MIDH. NHB will also house the national level Technical Support Group (TSG) under MIDH including NHM and NBM and extend administrative, logistical, and personnel support towards their implementation. List of NHB schemes is given as under:
 1. Development of Commercial Horticulture through Production and Post-Harvest Management of Horticulture Crops.
 2. Capital Investment Subsidy Scheme for construction/expansion/modernization of Cold Storages/Storages of Horticulture Products.
 3. Technology Development and Transfer for promotion of Horticulture.
 4. Market Information Scheme for horticulture crops.
 5. Horticulture Promotion Services/Expert Services.

5.2 NATIONAL MISSION ON AGRICULTURE EXTENSION AND TECHNOLOGY (NMAET)

The aim of the mission is to restructure and strengthen agricultural extension to enable delivery of appropriate technology and improved agronomic practices to the farmers. This is envisaged to be achieved by a judicious mix of extensive physical outreach and interactive methods of information

dissemination, use of ICT, popularization of modern and appropriate technologies, capacity building and institutional strengthening to promote mechanization, availability of quality seeds, plant protection, etc. and encourage aggregation of farmers into Interest Groups (FIGs) to form Farmer Producer Organizations (FPOs).

NMAET includes four Sub-Missions:

1. **Sub-Mission on Agriculture Extension (SMAE):** Agriculture extension may be defined as the “delivery of information inputs to farmers to increase agricultural productivity”. It is the application of scientific research and knowledge to agricultural practices through farmer education. SMAE will focus on awareness creation and enhanced use of appropriate technologies in agriculture and allied sectors. Personnel trained under Agri-Clinics and Agri-Business Centers Scheme (ACABC) and Diploma in Agriculture Extension Services for Input Dealers (DAESI) will also provide extension services to the farmers.
2. **Sub-Mission on Seed and Planting Material (SMSP):** The interventions included in SMSP will cover entire gamut of seed chain from nucleus seed to supply to farmers for sowing and also to major stakeholders in the seed chain and also provide for support for infrastructure to create an enabling environment for development of the sector. SMSP also envisages strengthening of Protection of Plant Varieties and Farmers’ Rights Authority (PPV&FRA) in order to put in place an effective system for protection of plant varieties, rights of farmers and plant breeders and to encourage development of new varieties of plants.

Protection of Plant Varieties and Farmer Rights Act (PPV&FR) 2001 aims at an effective system for IPR protection of plants varieties and rights of breeders, including farmers. The protection period is 15 years, and 18 years in case of trees and vines.

Objectives of the Act are:

1. To recognize and protect the rights of farmers in respect of the contributions made by them at any time in conserving, improving and making available plant genetic resources for the development of new plant varieties.
2. To accelerate agricultural development in the country, protect plants breeders’ rights, stimulate investment for research and development in both public and private sector or the development of new plant varieties.
3. Facilitate the growth of seed industry in the country.

A farmer is entitled to save, use, sow, resow, exchange, share or sell his farm produce including seed or variety protected under PPV&FR Act 2001 **without the brand name.**

3. **Sub-Mission on Agriculture Mechanization (SMAM):** SMAM will focus on farm mechanization. The Sub-Mission will cater to the needs of the small and marginal farmers through institutional arrangements such as custom hiring centers, mechanization of selected villages, subsidy for procurement of machines and equipment, etc.
4. **Sub-Mission on Plant Protection and Plant Quarantine (SMPP):** It envisages an increase in agricultural production by keeping the crop disease free using scientific and environment friendly techniques through promotion of Integrated Pest Management.

5.3 NATIONAL MISSION ON OILSEEDS AND OIL PALM (NMOOP)

NMOOP launched during 2014-15 envisages increasing production and productivity of oilseeds crops and oil palm through bringing in fallow areas under oilseed crops and diversification of area from low yielding cereals. It aims to achieve the required target by addressing major constraints to crop productivity through promotion of relevant technological interventions.

The **strategy under NMOOP** involves increasing seed replacement ratio; increasing irrigation coverage from 26% to 36%; diversification of area from low-yielding cereal crops to oilseeds crops; inter-cropping of oilseeds with cereals/pulses/sugarcane; use of fallow land after paddy/potato cultivation; expansion of cultivation of Oil Palm in wastelands and watersheds; increasing availability of quality planting materials of oil palm and Tree Borne Oilseeds (TBOs); enhancing procurement of oilseeds and collection and processing of TBOs.

The **mission includes three mini missions:**

1. **Mini Mission I:** Increase production and productivity of oil seeds.
2. **Mini Mission II:** Bring additional 1.25 lakh hectares area under oil palm cultivation through area expansion approach in the states including utilization of wastelands with increase in the productivity of fresh fruit bunches.
3. **Mini Mission III:** Enhance seed collection of TBOs from 9 lakh tonnes to 14 lakh tonnes and to augment elite planting materials for area expansion under waste land.

5.4 NATIONAL SAFFRON MISSION

National Saffron Mission started almost a decade ago to boost the production of the prized product in Kashmir valley. The programme was launched with the objective of increasing saffron production, quality, and boosting growers' income by doubling it. The revival programme was aimed to employ scientific techniques to rejuvenate saffron bulbs, as well as to provide groundwater irrigation through borewells and sprinklers, power tillers, and a high-tech saffron park with mechanized processing as well as a testing laboratory and e-trading facility.

5.5 TECHNOLOGY MISSION ON OILSEEDS, PULSES AND MAIZE (TMOP)

The **schemes included under TMPO** are:

1. Oilseeds Production Program (OPP)
2. National Pulses Development Program (NPDP)
3. Accelerated Maize Development Program (AMDP)
4. Post-Harvest Technology (PHT)
5. Oil-palm Development Program (OPDP)
6. National Oilseeds and Vegetable Oils Development Board (NOVOD)

In 2004, during 10th Five Year Plan period, OPP, OPDP, AMDP, and NPDP were merged into Centrally Sponsored **Integrated Scheme of Oilseeds, Pulses, Oil Palm and Maize (ISOPOM)**. ISOPOM aims to provide flexibility to the States in implementation of these programmes based on regionally differentiated approach and to promote crop diversification and to provide focused approach to the programmes.

5.6 NATIONAL MISSION ON SUSTAINABLE AGRICULTURE (NMSA)

NMSA aims at making agriculture more productive, sustainable, remunerative, and climate resilient by

1. Promoting sustainable agriculture best suited to the specific agro-ecology.
2. Promoting integrated farming.
3. Ensuring appropriate soil management.
4. Synergizing resource conservation technology.
5. Mainstreaming rainfed technologies.
6. Promoting efficient water management practices.

5.7 NATIONAL FOOD SECURITY MISSION (NFSM)

In the view of stagnating food grain production and an increasing consumption need of the growing population, Government of India (GOI) launched this Centrally Sponsored Scheme, 'National Food Security Mission' in October 2007.

The Mission met with an overwhelming success and achieved the targeted additional production of rice, wheat and pulses. The mission continued during 12th Five Year Plan with new targets of additional production of food grains of 25 million tonnes of food grains comprising of 10 million tonnes of rice, 8 million tonnes of wheat, 4 million tonnes of pulses, and 3 million tonnes of coarse cereals by the end of 12th Five Year Plan.

Based on the past experience and performance of 12th Plan, the programme is being continued up to 2019-20, which is co-terminus with 14th Finance Commission period. The targets to achieve are 13 million tonnes of additional foodgrains production comprising of Rice- 5 million tonnes, Wheat- 3 million tonnes, Pulses- 3 million tonnes, and Coarse Cereals- 2 million tonnes.

In NFSM during 2016-17, new initiatives to enhance production and productivity such as creation of seed hubs, technology demonstration by Krishi Vigyaan Kendras (KVKs), use of bio fertilizers and bio agent labs, etc. has been adopted.

5.8 RASHTRIYA KRISHI VIKAS YOJANA (RKVY)

RKVY was launched as a flagship scheme of the Department of Agriculture, Cooperation & Farmers' Welfare (DAC&FW) in 2007-08 to incentivize states to draw up comprehensive agricultural development plans, taking into account agro-climatic conditions, natural resources and technology for ensuring more inclusive and integrated development of agriculture and allied sectors. The scheme was implemented as a State Plan Scheme till the end of the financial year 2013-14 and is being implemented as a CSS (State Plan) scheme thereafter.

The Scheme has been revamped as the Rashtriya Krishi Vikas Yojana-Remunerative Approaches for Agriculture and Allied Sector Rejuvenation (RKVY-RAFTAAR) for implementation from 2017-18 to 2019-20 with a major focus on pre & post-harvest infrastructure, besides promoting agri-entrepreneurship, innovations & value addition.

Objectives of the RKVY-RAFTAAR scheme are:

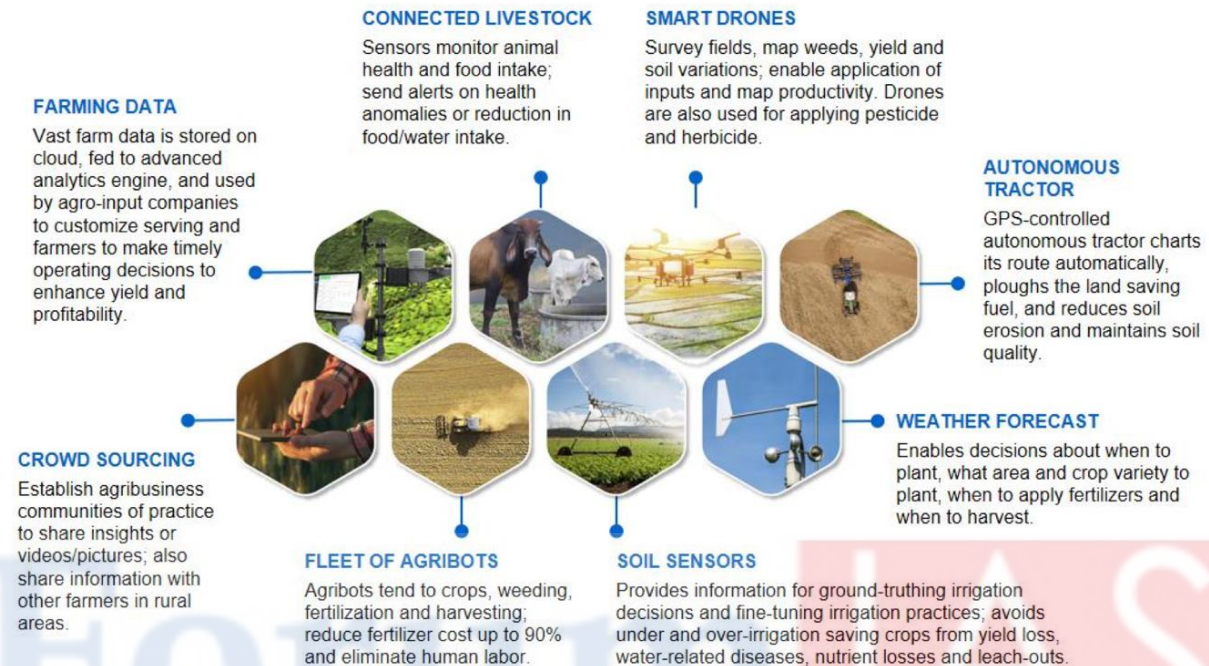
1. To strengthen the efforts of farmers through creation of pre and post-harvest agricultural infrastructure that increases access to quality inputs, storage, market facilities etc.
2. To provide autonomy, flexibility to States to plan and execute schemes as per local/farmers' needs.
3. To promote value chain addition linked production models that will help farmers increase their income as well as encourage production/productivity.
4. To mitigate the risk of farmers with focus on additional income generation activities-integrated farming, mushroom cultivation, bee keeping, aromatic plant cultivation, floriculture, etc.
5. To attend to national priorities through several sub-schemes.
6. To empower youth through skill development, innovation and agri-entrepreneurship based agribusiness models that attract them to agriculture.

Forum IAS

CHAPTER 6

E-TECHNOLOGY IN THE AID OF FARMERS

E-Technology in agriculture refers to the usage of internet and related digital and information technologies in managing the business of agriculture.



ICT led 'precision farming' (an approach where inputs are utilized in precise amounts to get increased average yields)

6.1 NATIONAL e-GOVERNANCE PLAN IN AGRICULTURE (NeGP-A)

NeGP-A was introduced for the rapid growth in the agricultural sector with the help of Information and Communication Technologies (ICT). Key objectives of NeGP-A are:

1. Bringing in farmer-centric plans and service orientation programs.
2. Improving outreach of extension services.
3. Providing farmers with greater access to information, as well as various services coming under the scheme with the help of the crop-cycle program.
4. Enhancement and integration of existing information.
5. Communication Technologies' initiative of both the Centre and as well as the state Governments.
6. Redesigning processes to enhance their efficiency and effectiveness.
7. Effectively managing various schemes coming under Department of Agriculture Cooperation.
8. Promoting common frameworks for the project across different states.

Key benefits of the NeGP-A project are as follows:

1. Farmers get access to information and various services.
2. **Online agricultural services** would be provided across states.
3. **Grievances of the farmers** would be addresses in a faster and more efficient way.

4. Provision and **use of email services** across the department.
5. The department would become **more transparent and efficient**.
6. The farmers will be able to **give feedback** to the decision-makers.
7. Various government schemes made for farmers would be **monitored in a better and more efficient way**.
8. Resources can be managed more effectively.
9. Farmers can reap higher benefits and profitability.
10. Stakeholders can use information more effectively for decision making.
11. The project lays foundation for the **development of various e-businesses** in the agriculture sector.

Role of ICT in agriculture

1. **Information dissemination** throughout crop-cycle through technologies like satellite communication, Geographic Information System (GIS), video and mobile phones etc. regarding weather conditions, input requirements like seeds, fertilizers, soil health etc. **For e.g.**, DD Kisan.
2. **Increasing productivity through precision farming**. For e.g., Digital Spectrogram technology can assess soil health without transmitting the soil physically to a lab, by merely taking a spectral image of a soil sample. The spectral analysis can diagnose the contents of the sample and communicate results to the farmers almost instantly. This will enable farmers to make an informed choice regarding the agricultural input they have to put in their fields.
3. **Efficient agriculture marketing** by providing regular updates regarding prices for commodities, inputs, and consumer demands so that farmers could base their crop production depending on the market demands. For e.g., e-NAM.
4. **New employment opportunities** will be created in the digital field, thus reducing instances of disguised unemployment.
5. **Effective monitoring and analysis** of agricultural performance through ICT to reduce losses at various levels of supply chain.
6. ICT tools will increase **effectiveness of government service delivery** in quick estimation and timely compensation to farmers in the wake of disaster.
7. PM Fasal Bima Yojana (PMFBY) assesses crop damage to crops for insurance purposes through satellite and drone imagery. Using ICT tools will improve accuracy while estimating compensation claims under such insurance schemes.

Government has taken several ICT initiatives to improve extension services in agriculture like:

1. Agricultural services like pesticide registration, soil health testing laboratories etc.
2. Mobile applications for increasing awareness by providing information like **Kisan Suvidha** (farmers can seek advisories on their agricultural problems directly from the agriculture scientists).
3. Modernization of land records using **blockchain technologies** have been taken by states like Andhra Pradesh.
4. **e-NAM** has been launched to create a unified national market for agricultural commodities.
5. **Web portals** have been launched for farmer's convenience. For e.g., Crop Insurance Portal provides complete information related to crop insurance schemes.

6.2 DRONE TECHNOLOGY IN AGRICULTURE

An agricultural drone is an unmanned aerial vehicle used to help optimize agricultural operations, increase crop production, and monitor crop growth. Sensors and digital imaging capabilities can give farmers a richer picture of their fields. Using an agriculture drone and gathering information from it may prove useful in improving crop yields and farm efficiency. With the data that drones record from the crops, the farmers are able to analyze their crops and make educated decisions on how to proceed given the accurate crop information.

The aerial view provided by a drone can reveal many issues such as irrigation problems, soil variations, and pest and fungal infestations. Multispectral images show a near-infrared view as well as a visual spectrum view. The combination shows the farmer the differences between health and unhealthy plants, a difference not always clearly visible to the human eye. Thus, these views can assist in assessing crop growth and production. Crops can be surveyed at any time using agricultural drones, allowing for rapid identification of problems.

Another major benefit of using drone technology is that it can be used to monitor and control the use of pesticides properly. This allows minimizing the environmental impact of pesticides.

6.3 BIG DATA IN AGRICULTURE

In agriculture, big data is often viewed as a combination of technology and analytics that can collect and compile novel data and process it in a more useful and timely way to assist decision making. According to agriculture funders, the big data comprises capturing relevant data from a huge number of sources, collecting it today and translating it into actionable information to improve business processes and solve problems at scale and speed.

Data helps debt-laden farmers, insurance agencies, loan banks, seed companies, machine industry, and every big and small player. Data analysis not only creates greater awareness and more accurate knowledge, but it can also plug the lacunae in the supply and marketing chain of the industry.

Big Data can be useful in agriculture in the following ways:

1. **Development of new seed traits:** Access to plant genome with new ways to measure, map and drive information better products.
2. **Precision farming:** Big Data takes advantage of information derived through precision farming in aggregate over many farms. The resulting analytics, insights, and better decisions can then be deployed through precision farming techniques.
3. **Food tracking:** Use of sensors and analytics to prevent spoilage and food-borne illness.
4. **Effect on supply chains:** Scientific shifts in the supply chain of seed, crop inputs, and food driven by the democratization of technology and information.
5. **Commodity price forecasting:** The price of commodities fluctuates significantly. The price forecasting information will help farmers know the price of agricultural commodities in advance and use this input to decide as to which crop to sow. Government can also use this data while taking decisions on fixing MSP, import-export duty and other policy decisions.

6.4 INTERNET OF THINGS (IoT) IN AGRICULTURE

IoT in agriculture uses robots, drones, remote sensors and other computer imaging combined with continuously progressing machine learning and analytical tools for monitoring crops, surveying and mapping the fields and provide data to farmers for rational farm management plans to save both time and money.

Applications of IoT in agriculture are as follows:

1. **Robotics:** Weeding robots, harvesting robots, and material handling robots (they can lift heavy materials and perform tasks like plant spacing with high accuracy, therefore optimizing the space and plant quality, and reducing production costs).
2. **Drones:** Drones equipped with cameras and sensors are used for imaging, mapping, and surveying the farms.
3. **Remote sensing:** Remote sensing is used for crop monitoring, determining the weather patterns, and analyzing soil quality.
4. **Computer imaging:** Computer imaging involves the use of sensor cameras installed at different corners of the farm or drones equipped with cameras to produce images which undergo digital image processing. Image processing views the images in different spectral intensities such as infrared, compares the images obtained over a period of time and detects anomalies thus analyzing limiting factors and helps better management of farms.

6.5 ARTIFICIAL INTELLIGENCE (AI) IN AGRICULTURE

AI refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. An Accenture study says- digital farming and connected farm services can impact 70 million Indian farmers in 2020, adding USD 9 billion to farmer incomes. NITI Aayog in its “**National Strategy for Artificial Intelligence**” mentions the following significance of AI in agriculture:

1. **Soil health monitoring and restoration:** Image recognition and deep learning models have enabled distributed soil health monitoring without the need of laboratory testing infrastructure. For e.g., Berlin based agri-tech startup PEAT has developed a deep learning application called Plantix that reportedly identifies potential defects and nutrient deficiencies in the soil.
2. **Crop health monitoring and providing real time action advisories to farmers:** Varying weather patterns such as increase in temperature, changes in precipitation levels, and ground water density, can affect farmers especially in the rainfed areas of the country. AI can be used to predict advisories for sowing, pest control, and input control to ensure increased income and provide stability for the agricultural community.
3. **Increasing efficiency of farm mechanization:** Image classification tools combined with remote and local sensed data can bring a revolutionary change in utilization and efficiency of farm machinery, in areas of weed removal, early disease detection, produce harvesting and grading. For e.g., Microsoft in collaboration with ICRISAT, developed an AI Sowing App which sends sowing advisories to participating farmers on the optimal date to sow.

4. **Increasing the share of price realization to producers:** Current low levels of price realization to farmers are primarily due to ineffective price discovery and dissemination mechanism, supply chain intermediary inefficiency and local regulations. Predictive analytics using AI tools can bring more accurate supply and demand information to farmers, thus reducing information asymmetry between farmers and intermediaries.
5. **AI for precision farming:** NITI Aayog and IBM have partnered to develop a crop yield prediction model using AI to provide real time advisory to farmers. IBM's AI model for predictive insights to improve crop productivity, soil yield, control agricultural inputs, and early warning on pest/disease outbreak will use data from remote sensing (ISRO), soil health cards, IMD's weather predictions and soil moisture/temperature, crop phenology etc. to give accurate prescriptions to farmers.

6.6 BLOCKCHAIN TECHNOLOGY IN AGRICULTURE

Blockchain technology is most simply defined as a decentralized, distributed ledger that records the origin of a digital asset. The goal of blockchain is to allow digital information to be recorded and distributed, but not edited. **Uses of blockchain technology in agriculture** are as follows:

1. **Reducing transaction costs:** A digital trading platform based on blockchain technology directly connects each transacting party to the same dataset in a transparent manner. This reduces transaction costs and creates financial security and supply chain transparency.
2. **Good Agricultural Practices (GAP):** Blockchain technology in the agricultural sector can be used to record interlinked field practices such as Integrated Nutrient Management (INM), confirm good agricultural practices, validate resource use efficiencies, build traceability for the produce from farm to work, and prevent price extortion and delayed payments.
3. **Authentic supply chain:** The technology can be used to validate authenticity of planting material by keeping a record of high-resolution images of the material in transit, provide similar traceability of other items from source to farms, record every input until the point of consumption at farm level, etc. This immutable record keeping system can build checks in the input and output supply system. Since blockchain relies on a distributed ledger, it is considered more secure as it makes it difficult for anyone to compromise the integrity of the data.
4. **Land records modernization:** Indian states are digitizing land record with blockchain technology to establish property rights as land is a critical input to agriculture.

6.7 ROBOTICS IN AGRICULTURE

Robotics has the following uses in agriculture:

1. **Nursery management:** Robotics are commonly used in nurseries for seeding, potting, and harvesting of the plants.
2. **Agri-Input application:** Robots can undertake targeted spraying of pesticides and fertilizers, leading to precision farming.

3. **Grading and Sorting:** Grading and Sorting actions are performed by robots in warehouses and cold storages to automatically package, label and move the boxes containing agricultural produce to the next stage of handling.
4. **Robotic sensors:** These can be used for crop and soil health monitoring, assessing crop loss, incidences of pests and diseases, etc.
5. **Veterinary uses:** Robots are used in dairy facilities as in the case of feeding and milking machines. Similarly, in the fisheries sector, automated feeders and pond aeration systems are used.
6. **Drones:** Drone is a type of robot used for a variety of purposes like pesticide spraying, monitoring crop health, etc.
7. **Greenhouses:** In greenhouses, rain and light sensing robotic arms can automatically retract or cover the roof as per need.

6.8 SPACE TECHNOLOGY IN AGRICULTURE

The Ministry of Agriculture and Farmers Welfare has been pro-active in using space technology in the agriculture sector for its various programmes, such as, **FASAL** (Forecasting Agricultural output using Space, Agro-Meteorology & Land based observations) project, **CHAMAN** (Coordinated programme on Horticulture Assessment and Management using geo-iNformatics) project, **NADAMS** (National Agricultural Drought Assessment and Monitoring System) project, Rice-Fallow Area Mapping and Intensification, geo tagging of infrastructure and assets created under Rashtriya Krishi Vikas Yojana, and Crop Insurance. **Applications of space technology in agriculture** are as follows:

1. The space technology helps **getting fast and unbiased information about the crop situation** in the country. It provides digital data which can help in various analysis. This data can be used for various programmes, which need information on crop type, crop area estimates, crop condition, crop damages, crop growth, etc.
2. The Department of Agriculture, Cooperation and Farmers Welfare had launched KISAN [C(K)rop Insurance using Space technology and geoInformatics] project. The project envisages use of high-resolution remote sensing data for optimum crop cutting experiment planning and improving yield estimation.
3. It can be used for **mapping of ground water resources** at high resolution.
4. Space technology can be used for operationalization of **Early Warning System on weather patterns** like rain and temperature for deciding crops to be sown, irrigation, fertilizer application, spray of pesticides, etc. so as to facilitate farmers as an informed cultivator.
5. **Satellite communication** can be used for Farmers' Training and Advisory (Tele-Agri Medicine).
6. Satellite Navigation systems (GAGAN and NAVIC) can be used for **precision farming and geo-tagging of resources**.
7. **Real-time and accurate assessment** of losses caused by natural disasters (floods, droughts, cyclones, etc.) can be done for better risk management and implementation of crop insurance.

Remote sensing in agriculture

Remote sensing makes use of visible, near infrared and short-wave infrared sensors to detect and monitor the physical characteristics of an area by measuring its reflected and emitted radiation at a distance (typically from a satellite or aircraft).

Uses of remote sensing in agriculture are as follows:

1. Remote sensing can assist in crop classification.
2. Acreage under cultivation could be estimated in order to arrive at production estimates.
3. Geographical Information System (GIS) tools can accurately collect the data on crop health and diseases.
4. Chlorophyll content in the vegetation of a specific location can be measured.
5. Remote sensing gives data on soil moisture and helps in determining the quantity of moisture in the soil and hence the type of crop that can be grown in the soil.
6. Greenhouse gas emissions from rice paddies of a specific location can be monitored.
7. Crop losses can be monitored which would help in verifying insurance claims by the farmers.
8. Remote sensing can accurately monitor biodiversity and the impact of agro-ecology.

6.9 ADVANTAGES AND CHALLENGES IN THE SPREAD OF E-TECHNOLOGY

Advantages of E-Technology in Empowering Farmers

1. Cost optimization.
2. Transparency, e.g., Direct Benefit Transfer (DBT) through Jan-Dhan Yojana.
3. Having necessary information at their disposal through e-services will enable small and marginal farmers to take informed decision making.
4. Use of Blockchain Technology will ensure integrity and transparency in the overall system.
5. Minimize corruption by preventing leakages.
6. Breaking linguistic and diversity barriers by using Artificial Intelligence (AI) Chat Bots.

Challenges of E-Technology

1. Digital illiteracy.
2. Privacy issues.
3. Poor digital infrastructure like internet penetration, software issues, etc.
4. Many extension and advisory services are not available in local languages.
5. Huge investment is required to set up e-technology related infrastructure, at least in the initial phases.

As per the latest report by the Internet & Mobile Association of India (IAMAI), India had 227 million active internet users. With rising penetration of ICT in India, there is a scope for using this potential to digitally empower the farmers of our country which will transform the agricultural sector and play an important role in doubling the farmers' income.

CHAPTER 7

FOOD PROCESSING INDUSTRIES

Food processing is the transformation of agricultural products into food, or of one form of food into other forms.

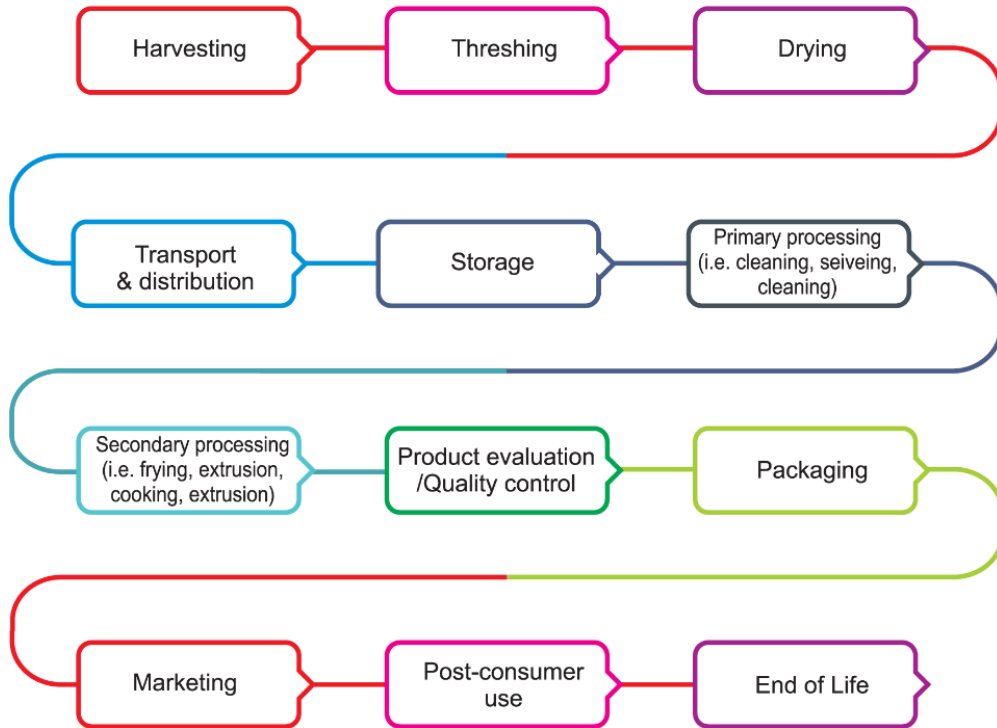
1. **Primary food processing:** It turns agricultural products, such as raw wheat kernels or livestock, into something that can eventually be eaten.
2. **Secondary food processing:** It is the everyday process of creating food from ingredients that are ready to use. Baking bread is an example of secondary food processing.
3. **Tertiary food processing:** It is the commercial production of what is commonly called processed food. These are ready-to-eat or heat-and-serve foods, such as re-heated airline meals.

Food processing industries have the following significance:

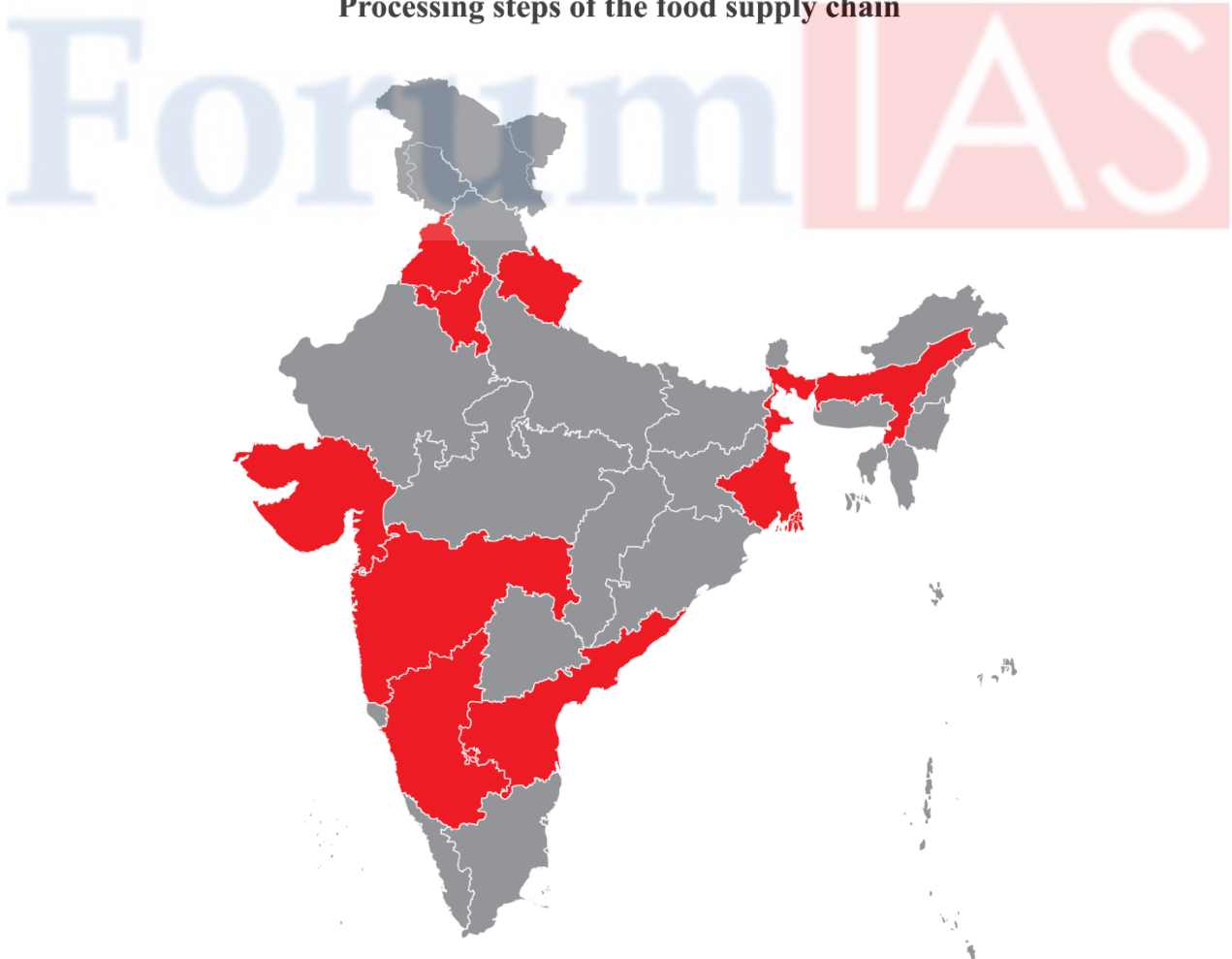
1. **Food wastage** can be reduced by diverting extra harvest to the food processing industries.
2. With increasing demand for processed foods, the demand for raw materials from farmers will also increase, thereby **raising their incomes**.
3. Processed foods **fortified with vitamins and minerals** raises the nutrition levels of the population.
4. Processed foods can be preserved, thus increasing their **shelf-life**.
5. High quality processed foods are in high demand in the international market, thus giving huge **scope for exports**.
6. Setting up food processing industries can be a huge **source of employment generation**.
7. Food processing industries promote **crop diversification** due to demands of diverse food items in the industry.
8. Encouraging food processing infrastructure in rural areas will generate employment and **reduce instances of distress migration** from rural to urban areas. As per the Annual Survey of Industries for 2016-17, the total number of persons engaged in registered food processing sector was 18.54 lakhs.

Food processing sector comprises of two broad segments viz. organized and unorganized segments. There are an estimated 25 lakh micro food processing enterprises in the country, which are unorganized and unregistered. With 7% of investment in plant and machinery, the unorganized enterprises contribute 74.3% of employment, 10% of output and 27% of value addition in the food processing sector. Nearly 66% of these units are located in rural areas and about 80% of them are family-enterprises.

The organized sector with nearly 40,000 units accounts for 93% of the plant & machinery in the sector, in value terms. This segment accounts for 26% of employment and contributes around 90% of output and 72% GVA.



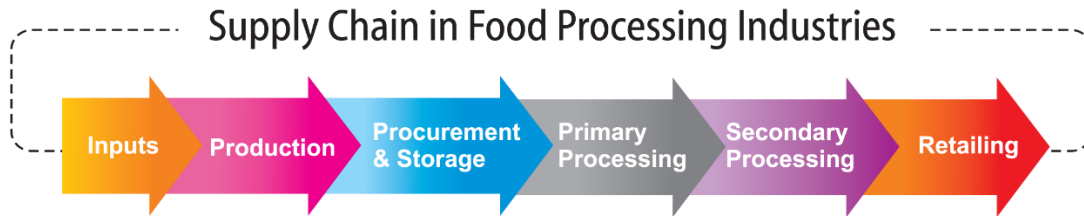
Processing steps of the food supply chain



Location of food processing industries in India

Supply Chain of the Food Processing Sector

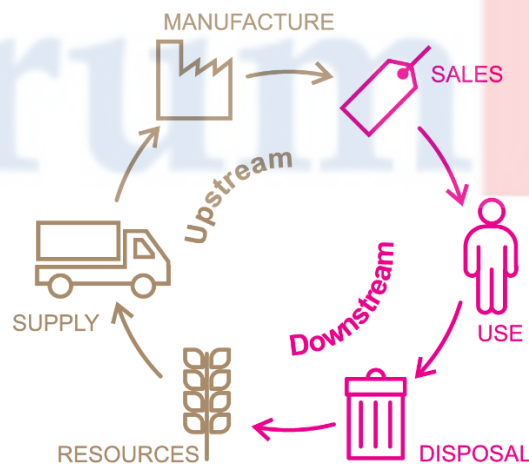
Supply chains are principally concerned with the flow of products and information between supply chain member organizations- procurement of materials, transformation of materials into finished products, and distribution of those products to end consumers. Supply chain represents the steps it takes to get the product or service to the customer.



Upstream and Downstream activities

Upstream operations refer to points in production that originate early on in the processes. This process includes searching for and extracting the raw materials but does not do anything with the material itself, such as processing the material.

Downstream operations involve processing the materials collected during the upstream stage into an end product which then flows away from the organization to the customers.

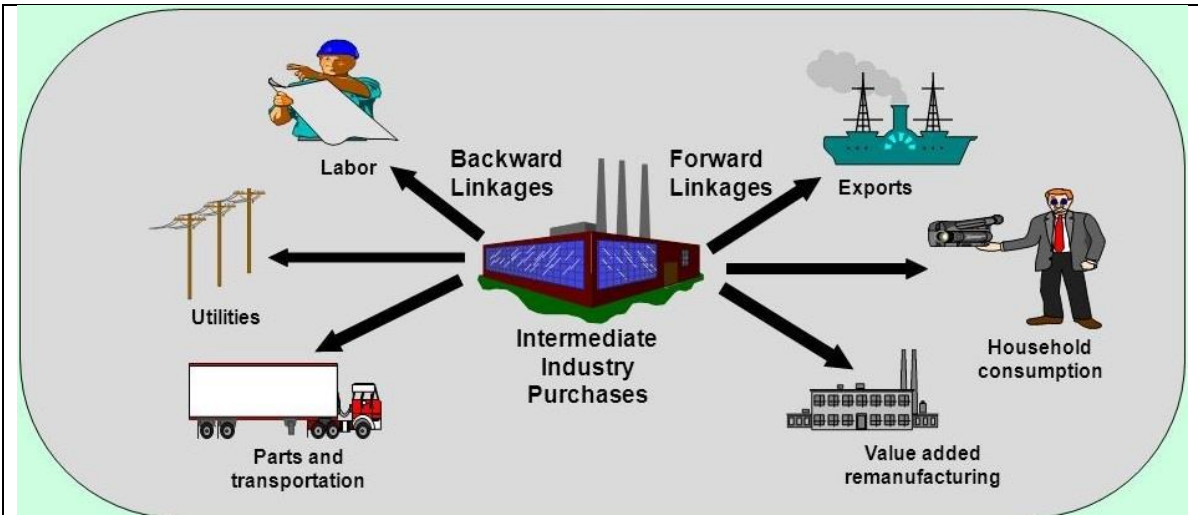


Upstream and Downstream operations

Backward and Forward linkages

Backward linkages refer to the connectivity of the Food Processing Industries (FPIs) with sources of raw material supply.

Forward linkages refer to the connectivity of the Food Processing Industries (FPIs) with the markets through distribution networks like roads, railways, etc.



Backwards and Forward Linkages

Significance of backward linkages are as follows:

1. It encourages farmers to grow produce of appropriate quality.
2. Farmers get adequate returns on their produce.
3. Wastage of food products, especially those with low shelf-life is minimized.

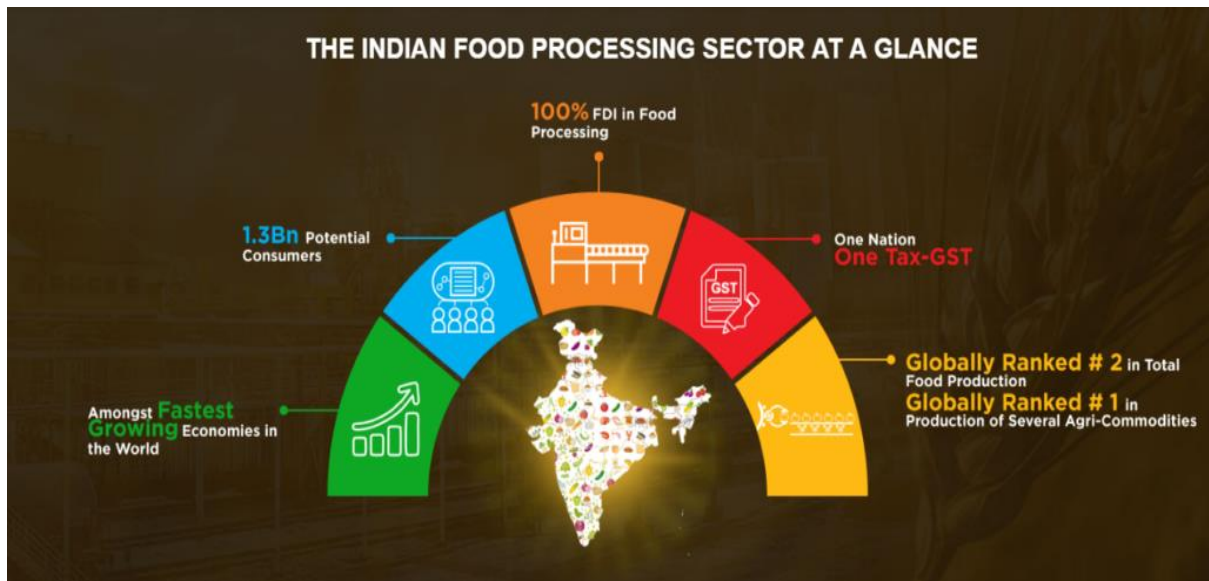
Significance of forward linkages are as follows:

1. It ensures timely delivery of processed food products to the consumers.
2. It promotes creation of physical infrastructure like roads and railways.
3. Food safety standards are maintained which leads to greater acceptability of processed foods in the domestic as well as international markets.

However, the **backward and forward linkages continue to face a multitude of challenges** in India like:

1. Substandard levels of food processing industries.
2. Underdeveloped transport infrastructure like road and rail networks.
3. Fragmented landholding leads to low levels of marketable surplus for the food processing industries.
4. Absence of cold-storage infrastructure causes much of the perishable products to be destroyed.
5. Multiplicity of legislations leads to conflicting approach, lack of coordination and administrative delays.
6. Domestic food laws are not in consonance with international food safety standards. Also, food testing laboratories are under developed and insufficient in number.

Food processing sector has great potential in India. As India moves from a food scarce to a food surplus nation, the opportunities for increasing food processing levels are immense.



Scope of food processing industry in India

Potential of processed food sector in India are as follows:

1. **Huge demand:** With a population of more than 1.3 billion individuals, demand for processed food is huge.
2. **Rising middle class:** As more and more citizens move into the middle-income age bracket, the demand for nutritional food increases. This demand can be fulfilled by the food processing industries.
3. **Agrarian economy:** India being an agrarian economy with around 50% of the population engaged in agriculture, there is sufficient supply of raw materials for food processing industries to flourish.
4. **Surplus production:** India's foodgrain production has exceeded the demand, thereby ensuring that we have surplus grains in stock. This surplus stock can be diverted to meet the demands of the food processing industries.
5. **Investments:** With 100% FDI allowed in this sector, India's food processing sector has become an attractive destination for global investors as it received FDI inflows worth USD 904.70 million in 2019-20 (up by 44% over 2018-19).
6. **Infrastructure:** Government has initiated projects like Sagarmala and Bharatmala, which has led to creation of physical infrastructure like ports, roads, and railways.
7. **Export competitiveness:** India's exports have a competitive edge compared to other countries due to cheap cost of raw materials.
8. **Employment generation:** Food processing industries will generate non-farm employment in the rural areas and help reduce disguised unemployment in the agricultural sector.
9. **Conducive legislations:** Government has brought favourable legislations like Goods and Service Tax (GST) which will improve Ease of Doing Business in India.

However, the **food processing sector in India faces certain challenges** as well:

1. **Gaps in supply chain infrastructure** which means inadequate primary processing, storage and distribution facilities.
2. Insufficient connection between production and processing.
3. **Seasonality of operations** and low-capacity utilizations.
4. **Institutional gaps in the supply chains**, for e.g., there is dependence on APMC markets.

5. Lack of focus on **quality and safety standards**.
6. Insufficient product development and **innovation**.
7. **Bureaucratic hurdles**, for e.g., multiple clearances are required for setting up food processing units.
8. **Informalization in food processing industry** which causes inefficiency in the existing production system.
9. Food processing sector, largely operating in the MSME segment, face problem in their **access to bank credit** due to seasonal and perishable nature of the commodities handled by these units.

In order to solve the above challenges, **government initiated several schemes for the food processing sector:**

1. **PM Kisan SAMPADA Yojana:** Government of India initiated a new Central Sector Scheme- PM Kisan SAMPADA Yojana with an allocation of Rs. 6000 crores for the period 2016-20. The scheme will be implemented by **Ministry of Food Processing Industries (MoFPI)**.

PM Kisan SAMPADA Yojana is a comprehensive package which will result in creation of modern infrastructure with efficient supply chain management from farm gate to retail outlet. It will not only provide a big boost to the growth of food processing sector in the country but also help in providing better returns to farmers and is a big step towards doubling of farmers income, creating huge employment opportunities especially in the rural areas, reducing wastage of agriculture produce, increasing the processing level and enhancing the export of processed foods.

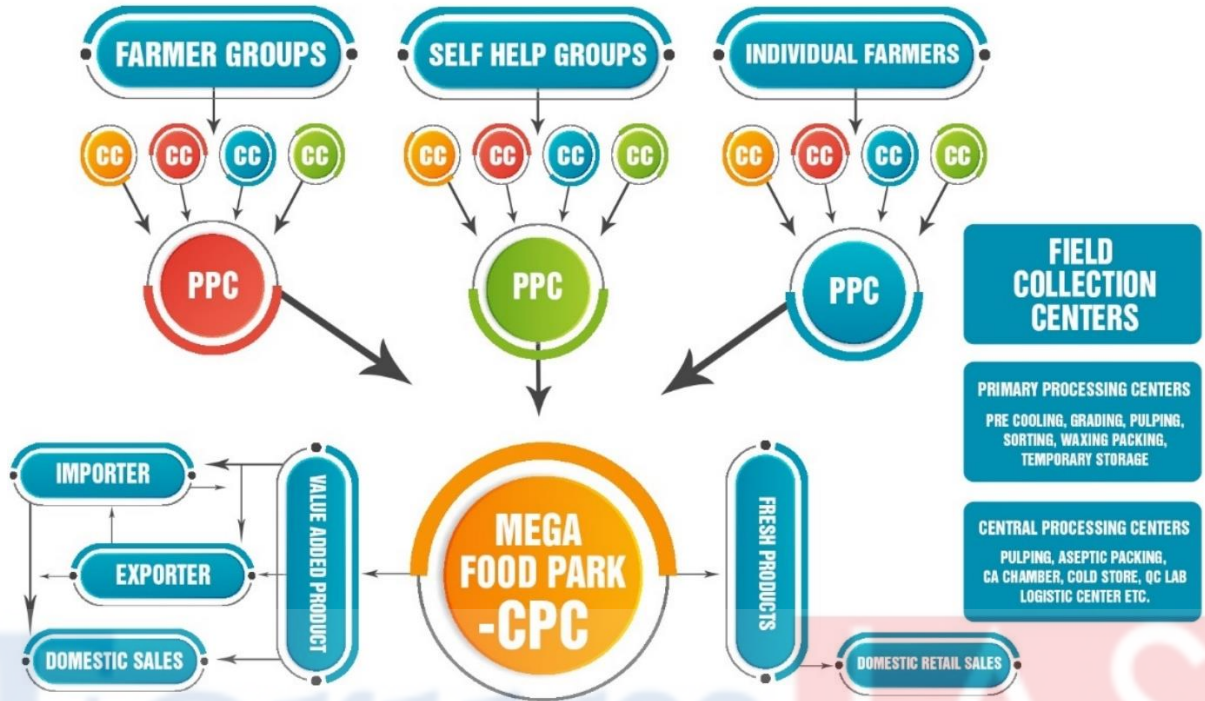
The following schemes will be implemented under PM Kisan SAMPADA Yojana:

1. Mega Food Parks
 2. Integrated Cold Chain and Value Addition Infrastructure
 3. Creation/Expansion of Food Processing/Preservation Capacities
 4. Infrastructure for Agro-processing Clusters
 5. Creation of Backward and Forward Linkages
 6. Food Safety and Quality Assurance Infrastructure
 7. Human Resources and Institutions
2. **Mega Food Parks Scheme:** The Scheme of Mega Food Park aims at providing a mechanism to agricultural production to the market by bringing together farmers, processors and retailers so as to ensure maximizing value addition, minimizing wastage, increasing farmers income and creating employment opportunities particularly in rural sector. The Mega Food Park Scheme is based on “**Cluster**” approach and envisages creation of state of art support infrastructure in a well-defined agri / horticultural zone for setting up of modern food processing units in the industrial plots provided in the park with well-established supply chain. Mega food park typically consists of supply chain infrastructure including **collection centres, primary processing centres, central processing centres, cold chain** and around 25-30 fully developed plots for entrepreneurs to set up food processing units.

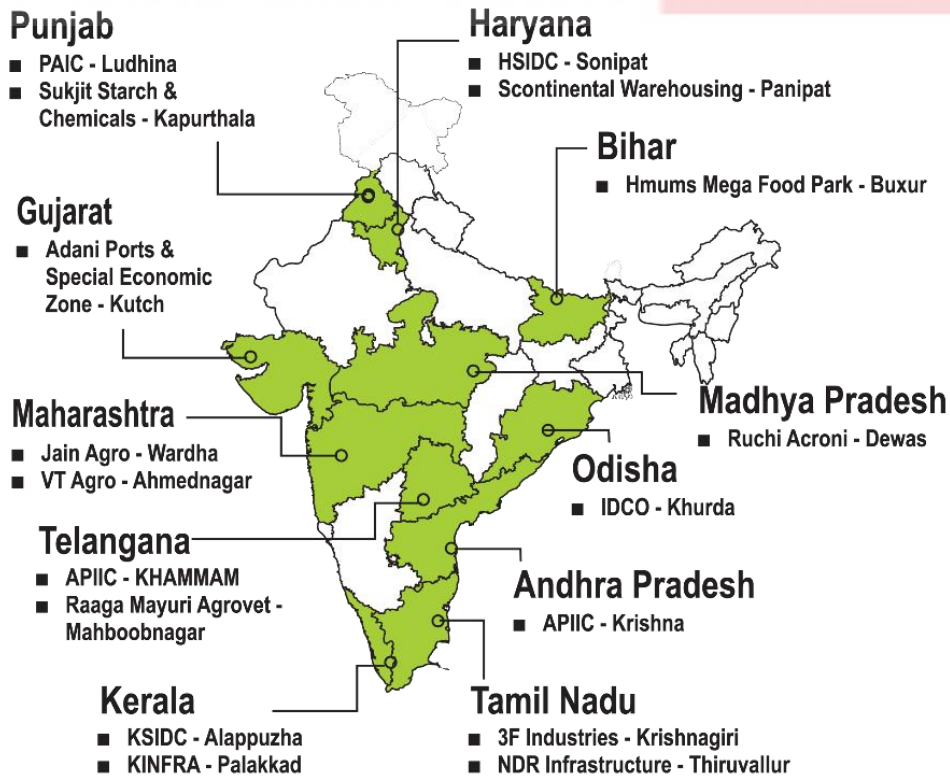
The Mega Food Park project is implemented by a **Special Purpose Vehicle (SPV)** which is a Body Corporate registered under the Companies Act. State Government, State Government entities and Cooperatives are not required to form a separate SPV for implementation of Mega Food

Park project. Subject to fulfilment of the conditions of the Scheme Guidelines, the funds are released to the SPVs.

MEGA FOOD PARK MODEL



MEGA FOOD PARKS



3. **Gram Samridhi Yojana:** It aims to bolster the **unorganized food processing sector** concentrated in rural areas. The Rs. 3000 crore scheme funded by the **World Bank and the centre** will help cottage industry, farmer producers' organizations and individual food processors to increase capacity, upgrade technology besides skill improvement, entrepreneurship development and strengthening the farm-to-market supply chain.
4. **TRIFOOD Project:** "TRIFOOD Project" is being implemented by **TRIFED, Ministry of Food Processing Industries (MoFPI), and Ministry of Tribal Affairs (MoTA)**. TRIFOOD seeks to improve the income of tribals with the help of better utilization of Minor Forest Produce (MFP) collected by tribal forest gatherers.
5. **Food Processing Fund:** A special fund in the NABARD worth Rs. 2,000 crores, designated as Food Processing Fund, was set up for providing affordable credit to food processing units in Mega & Designated Food Parks.
6. **Research & Development (R&D):** Important institutes like NIFTEM (National Institute of Food Technology Entrepreneurship and Management) for technology improvement and R&D in the Food Processing Sector.
7. **Draft National Food Processing Policy-2019:** The draft policy aims for the development of the food processing sector and addressing critical gaps hampering its growth. **Key features** of the draft policy are:
 1. **Infrastructure development:** The draft policy seeks to incentivise the creation of supply chain infrastructure for the food processing sector.
 2. **Training and skill development:** The draft policy proposes various incentives for promotion of employment such as:
 1. Promoting employee welfare.
 2. Facilitating farmers to set up food processing units, and
 3. Promoting food processing training cum incubation centres.
 4. It also proposes starting new courses and conducting research in food technology, entrepreneurship, and management.
 3. The draft policy proposes **various incentives** that can be provided for the growth of the sector. These include:
 1. Capital investment subsidy for setting up new food processing units and technology upgradation of existing units.
 2. Fiscal incentives such as lower Goods and Services Tax rates on food products and food processing machineries, and
 3. Certain electrical duty and land-related concessions may also be provided.
8. **One District One Product Scheme (ODOP):** It is an initiative which is seen as a transformational step forward towards realizing the true potential of a district, fuel economic growth and generate employment and rural entrepreneurship, taking us to the goal of AtmaNirbhar Bharat. ODOP initiative is operationally merged with 'Districts as Export Hubs' initiative being implemented by DGFT, Department of Commerce, with the Department for Promotion of Industry and Internal Trade (DPIIT) as a major stakeholder.

The objective of the scheme is to convert each district of the country into an export hub by identifying products with export potential in the district, addressing bottlenecks for exporting these products, supporting local exporters/manufacturers to scale up manufacturing, and find

potential buyers outside India with the aim of promoting exports, promoting manufacturing & services industry in the district and generate employment in the district.

9. **Scheme for formalization of Micro Food Processing Enterprises:** MoFPI, in partnership with the State/UTs, has launched an all India Centrally Sponsored **PM Formalization of Micro Food Processing Enterprises Scheme (PM FME Scheme)** for providing financial, technical and business support. The Scheme will be implemented for a period of five years from 2020-21 to 2024-25. 2,00,000 micro-enterprises are to be assisted with credit linked subsidy.

Eligibility under the scheme are as follows:

1. Scheme is on an **All India basis**.
2. **Support to individual micro-units:**
 1. Micro enterprises will get credit linked subsidy @ 35% of the eligible project cost with ceiling of Rs. 10 lakhs.
 2. Beneficiary contribution will be minimum 10% and balance will come from loan.
 3. On-site skill training & handholding for technical upgradation.
3. **Support to FPOs/SHGs/Cooperatives:**
 1. Seed capital will be given to SHGs (@ Rs. 4 lakhs per SHG) for loan to members for working capital and small tools.
 2. Grant for backward/forward linkages, common infrastructure, packaging, marketing, and branding.
 3. Skill training and handholding support.
 4. Credit linked capital subsidy.

Objectives of the scheme are:

1. Increase in access to finance to micro food processing enterprises.
2. Increase in revenues of target enterprises.
3. Enhanced compliance with food quality and safety standards.
4. Strengthening capacities of support systems.
5. Transition from unorganized sector to the formal sector.
6. Special focus on women entrepreneurs and aspirational districts.
7. Focus on minor forest produce in tribal districts.

Some of the steps which can be further undertaken to encourage our food processing industry (FPI) are as follows:

1. Improving storage capacities and infrastructure.
2. **Public investment** in the sector needs to be encouraged.
3. **Connectivity infrastructure** needs to be improved.
4. Backward linkages need to be strengthened. For this, contract farming can be promoted.
5. The **North-Eastern regions, the Hilly States, the Island areas** should be given special consideration as they are naturally conducive for FPIs. Considering this factor, Zoram Mega Food Park, Mizoram's 1st such park was set up by MoFPI.
6. **Better access to credit** by facilitating disbursement of bank loans to FPIs at low interest rates.
7. **Encourage technology upgradation** of existing facilities and investment in the development of ancillary industries like R&D, packaging, food processing equipment manufacturing, etc.

8. **Streamlining the regulatory infrastructure** by removing impediments of multiple departments and laws in seeking approvals by bringing them under a single window.

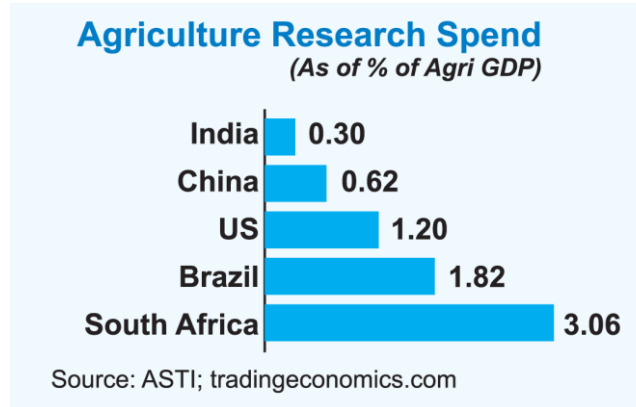
Government needs to focus on removing the constraints through the above steps, which will enable us to reap the potential benefits of food processing sector in India and make agriculture a remunerative profession.

Forum IAS

CHAPTER 8

AGRICULTURAL RESEARCH AND DEVELOPMENT

Since the Ninth Five-Year Plan (1997-2002), efforts have been made to enhance R&D spending to 1% of agricultural GDP by the end of each plan period. This target, however, has not been fulfilled till date due to 'tight fiscal situation'. Spending on agricultural R&D in India still hovers around 0.30% of agricultural GDP (about Rs. 8000 crores in 2019-20), while most other countries spend more than 1%.



About 80% of R&D funding goes to paying salaries and other expenditure, leaving little to conduct comprehensive mission-mode research ventures. Such minuscule levels of investment in R&D impedes the ability of science and technology (S&T) research to tackle multiple challenges that include yield gaps, changing consumer preferences, declining resources capacity, the geopolitical situation, and the adverse impact of climate change leading to farm distress.

Apart from funding, there are other challenges in the agricultural R&D as well. For example, Indian agricultural research has become 'cereal centric' and there is limited focus on pulses, oilseeds, and horticulture. Also, much of the research focusses on improving the quantitative and not qualitative yield.

8.1 AGRICULTURE EDUCATION

Formal agricultural education in India is mostly confined to higher educational institutions. Currently, there are three central agricultural universities, around 65 State Agricultural Universities (SAUs), and 4 Deemed-to-be-Universities (DUs) in India which focus on imparting formal education in the field of agriculture.

Agricultural education holds great significance in India due to the following reasons:

1. It will encourage more research and development in emerging fields like nanotechnology, genetic engineering, biotechnology, etc.
2. Technical education will empower the farmers by providing them knowledge regarding sustainable agricultural practices like organic farming, zero budget farming, micro irrigation, accurate use of chemical fertilizers, etc. This will help them minimize environmental damage, ensure food security in the future, and adapt and mitigate for climate change.

3. Agricultural education will impart the farmers with the necessary skills required in food processing industries, marketing of produce, etc.
4. More young students will be encouraged to pursue agriculture as a favorable and remunerative profession.
5. Development of analytical professional skills and knowledge in areas such as Intellectual Property Rights (IPRs), WTO's Sanitary and Phytosanitary Measures (SPS), etc. will boost agricultural exports in changing globalized scenario.
6. Agro-entrepreneurship will get a boost, especially in the rural areas, making villages self-sufficient.
7. Agricultural education will make the farmers more aware of marketing systems, functioning of supply chains, contract farming, etc. and reduce the information asymmetry in the agricultural sector.

However, the **field of agricultural education is plagued with several problems** like shortage of competent faculty, difficulty in attracting talented rural and urban youth due to low returns and limited career opportunities, inadequate funding support, outdated curriculum, and lack of significant efforts by the state governments. Further, NITI Aayog notes that there has been a proliferation of self-financed private agricultural colleges without sufficient facilities, proper labs or infrastructure.

Considering the above issues, **government has launched several initiatives for agriculture education** like:

1. **ARYA (Attracting and Retaining youth in Agriculture):** The scheme aims to attract and empower the youth in rural areas to take up various agriculture, allied and service sector enterprises for sustainable income and gainful employment through skill development.
2. **Student READY (Rural Entrepreneurship Awareness Development Yojana):** It provides job based and entrepreneurial training to students.
3. **NAHEP (National Agricultural Higher Education Project):** It is designed to strengthen the national agricultural system in India with an overall objective to provide more relevant and high-quality education to agricultural university students.

Some of the steps which can further be taken to promote agricultural education includes updating the course curriculum to keep pace with the changing agricultural scenario and developing technology, training the academic staff, incorporating basic agricultural subjects at pre-high school and higher secondary level with the purpose of imparting firsthand knowledge on agriculture, providing students guidance and counselling to prepare them for the job market, and initiating an effective accreditation system for monitoring the quality of State Agricultural Universities (SAUs).

Also, in its past reports, Economic Survey had recommended that instead of creating more institutions, we should focus on the quality of research and infrastructure in the existing agricultural institutions. Also, ICAR should be given UGC like power to better regulate the private agricultural colleges.

8.2 GM CROPS

A Genetically Modified (GM) or transgenic crop is a plant that has a novel combination of genetic material obtained through the use of modern biotechnology mainly using recombinant DNA (rDNA) technology.

India currently has commercialized only one GM crop, the Bt Cotton with Cry 1 AC gene (Bollgard 1). India is at the 4th position in hectareage under GM crops. As per official data for the 2018-19 kharif season, 88.27% of the 122.38 lakh hectares cultivation is under Bt Cotton of all varieties.

(In million hectares)

Global Area of Biotech Crops				
	2010	2011	2012	Crops
US	66.8	69	69.5	Maize, Soyabean, Cotton, Sugarbeet Papaya, Squash
Brazil	25.4	30.3	36.6	Soyabean, Maize, Cotton
Argentina	22.9	23.7	23.9	Soyabean, Maize, Cotton
Canada	8.8	10.4	11.6	Canola, Maize, Soyabean, Sugarbeet
India	9.4	10.6	10.8	Cotton
China	3.5	3.9	4	Cotton, Papaya, Poplar, Tomato, Sweet pepper
Total*	148	160	170.3	

*Includes 22 other countries such as Paraguay, South Africa, Pakistan & Uruguay.
Source: Clive James

Source- Hindu business Line

Other GM crops

1. **Bt Brinjal:** It was approved for cultivation by India's Genetic Engineering Appraisal Committee (GEAC) in October 2009. But stiff opposition led to infinite moratorium on its cultivation in February 2010. Activists raised issues like food safety and dependence of farmers on MNCs for seeds from the single firm that makes them due to terminal nature of seeds.
2. **GM Mustard:** GM Mustard is a genetically modified variant of mustard developed by the Delhi University's Center for Genetic Manipulation of Crop Plants. It has the genes that allow the plant cross-pollination and hybridization. GEAC has recommended cultivation of GM Mustard, taking it closer to becoming India's first GM crop.

Those opposing GM Mustard are against the genetic modification technology in agriculture over food safety issues. Anti-GM activists say that claims that the variant, DMH11, has a 30% higher yield are false. Also, regular seeds can be reused, are cheap and widely available. GM seeds can't be reused and must be bought. They contain the so called '**terminator technology**' meaning that they have been genetically modified so that resulting crops do not viable seeds of their own.

Policy framework for GM crops

1. **Genetic Engineering Appraisal Committee (GEAC)** is a statutory body constituted under the 'Rules for the Manufacture, Use, Import, Export and Storage of Hazardous Microorganisms/Genetically Engineered Organisms or Cells, 1989' notified under the Environment (Protection) Act, 1986. Since 1989, GEAC under the Environment Ministry has been responsible for approving commercial cultivation of GM crops as well as the manufacture, import and selling of processed foods made from GM ingredients.

2. **GM imports** require approvals under two laws- the Environment (Protection) Act, 1986 and the Food Safety and Standards Act, 2006.
3. **Codex Alimentarius Guidelines (Codex)** is the joint FAO/WHO intergovernmental body responsible for developing the standards, codes of practice, guidelines, and recommendations that constitute the Codex Alimentarius, meaning the international food code. Codex developed principles for human health risk analysis of GM foods in 2003.

GM crops offers benefits like:

1. GM crops are less labor-intensive and hence is cost-efficient.
2. GM crops are better tolerant to different harsh climatic conditions like droughts, salinity, etc.
3. GM crops have an increased level of protection against pests and diseases.
4. Commercial cultivation of GM crops is vital to our food security needs. For e.g., Bt cotton greatly contributed to a significant increase in farm income and India's transformation from a cotton importer into an exporter of cotton.
5. Reduced use of pesticides and herbicides in case of GM crops improve soil fertility.
6. GM crops have improved processing characteristics leading to reduced wastage and lower food costs to the consumers.

There are **certain concerns with GM crops** as well:

1. Anti GM activists claim that GM crops are unfit for consumption and create **food safety issues**.
2. GM crops have **terminator technology**, leading to MNCs monopolizing markets.
3. There are concerns that introduction of GM crops may lead to a **reduction of biodiversity in such areas**.
4. It has been reported that more and more pests have evolved **resistance to toxins** produced by GM crops. For e.g., pink bollworm has become a potent threat to GM cotton.
5. There is a fear that farmers are preferring GM crops over traditional varieties due to higher productivity and better returns, leading to the **practice of monoculture**.
6. **Regulatory failure** on the part of the government to monitor the cultivation of GM crops have led to several cases of cultivation of illegal GM crops like GM soyabean.

In order to solve the above challenges, some of the steps which can be taken are as follows:

1. There is a need for stringent regulation in the sector to ensure cultivation and sale of environmentally safe agro products. The FSSAI must identify all GM products being sold in the market and prosecute companies and traders responsible.
2. There should be a liability clause, that is, if something goes wrong, the liability should be fixed statutorily.
3. All the grievances of farmers and the public must be resolved before allowing disputed GM crops like GM Mustard. Transparent procedures must be followed by putting the safety documents online so that trust can be built among the public.
4. Government should come up with a National Policy on GM crops to define the exact areas where GM is required by the country and where government will encourage public and private investment in GM technology.

8.3 NANOTECHNOLOGY IN AGRICULTURE

Nanotechnologies are the design, characterization, production, and application of structures, devices, and systems by controlling shape and size on a nanometer scale. **Use of nanotechnology in agriculture** involves the following:

1. Nano fertilizers and nano pesticides increase the productivity without decontamination of soils, waters.
2. Protection against several insects, pests, and microbial diseases through products like nanogels.
3. Nanotechnology can be used as sensors for monitoring soil quality of agricultural field and maintain the health of agricultural plants.
4. Nanotechnology has the prospective to improve the agriculture and food industry with novel nanotools for the controlling of rapid disease diagnostic, enhancing the capacity of plants to absorb nutrients among others.
5. In the food processing industry, antimicrobial nano emulsions are used for applications in decontamination of food equipment, packaging or food, nano-based antigen detecting biosensors for identification of pathogens contamination.

Nanotechnology has the potential to help in achieving sustainable agriculture and doubling farmers' income. However, **there are certain concerns regarding the use of nanotechnology** in agriculture:

1. Concerns of cytotoxic and genotoxic effects of cellular nanomaterials on Nano Agri Products.
2. **Risk of nanoparticles toxicity** is higher in plants due to their minuscule size that can easily translocate within plant body.
3. Lack of knowledge and development methods for risk and life-cycle assessment of nanotechnology in agriculture.
4. It **reduces bacterial diversity** in the soil.
5. Insufficient economic interest, regulatory issues and public opinion hamper the effective use of nanotechnology in agriculture.

In response to the above concerns, government released '**Guidelines for Evaluation of Nano-based Agri-inputs and food products**'. Objectives of the guidelines include:

1. To encourage research and development in the sector.
2. To help regulators assess the quality and safety of nano-based agriculture and food products.
3. To encourage Indian innovators and industries to develop new nano-based products and formulations.

The guidelines apply to Nano-Agri-Input Products (NAIPs), Nano-Agri Products (NAPs) and nano composites, sensors made from nanomaterials that require direct contact with crops, food and feed for data acquisition. They do not apply to conventional products or formulations with incidental presence of nanomaterials.

8.4 NATIONAL INITIATIVE ON CLIMATE RESILIENT AGRICULTURE (NICRA)

The ICAR has launched NICRA during 2010-11 with an outlay of 350 crores. The initiative will primarily enhance the resilience of Indian Agriculture covering crops, livestock and fisheries.

The initiative will involve strategic research on adaptation and mitigation. Accordingly, sponsored and critical research grants will be provided to fill the critical research gaps.

8.5 SYSTEM OF RICE INTENSIFICATION (SRI)

SRI is a combination of several practices those include changes in nursery management, time of transplanting, water, and weed management. It emphasizes altering of certain agronomic practices of the conventional way of rice cultivation. All these new practices are together known as System of Rice Intensification (SRI).

SRI is not a fixed package of technical specifications, but a system of production with four main components, viz., **soil fertility management, planting method, weed control, and irrigation management**. Rice yield increases with less water and with reduction in chemical inputs.

8.6 SUSTAINABLE SUGARCANE INITIATIVE (SSI)

SSI is an innovative set of agronomic practices that involves less seeds, raising seeds in a nursery, and following new planting methods, with wider spacing, and better water and nutrient management to increase the cane yields significantly. The SSI method of sugarcane cultivation was evolved from the principles of 'More with Less' followed in SRI and introduced in India by the WWF-ICRISAT collaborative project in 2009.

SSI methods can increase sugarcane yields by at least 20% with 30% less water and 25% reduction in chemical inputs.

8.7 NATIONAL INNOVATION ON CLIMATE RESELIENT AGRICULTURE (NICRA)

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8.8 KRISHI KALYAN ABHIYAAN

Krishi Kalyan Abhiyaan was started by the Agricultural Ministry in two phases- Phase 1 from 1st June 2018 till 15th August 2018 and Phase 2 from 2nd October 2018 to 25th December 2018. It aims to aid, assist, and advice farmers on how to improve their farming techniques. Also, farmers are trained in bee keeping, mushroom cultivation, and kitchen gardening. Further, advice on vaccination, artificial insemination, etc. will also be given.

8.9 KRISHI VIGYAN KENDRAS (KVKs)

KVK is an agricultural extension centre in India and the name means "farm science centre". The first KVK was established in 1974 in Pondicherry and since then, KVKs have been established in all states and the number continues to grow.

Usually associated with a local agricultural university, these centres serve as the ultimate link between the Indian Council of Agricultural Research (ICAR) and farmers, and aim to apply agricultural research in a practical, localized setting.

Some of the responsibilities of KVKs include on-farm testing, frontline-demonstration, capacity building, multi-sector support, and advisory services.

Agricultural R&D is a crucial determinant of agricultural productivity and production and therefore food prices and poverty. It is therefore important that we shift our focus towards the same. Budgetary allocation should explicitly recognize the expenditure on agricultural R&D as one of the prime areas for both environmental and livelihood sustainability. There is no dearth of innovations and palliatives to address farm distress.

It's time the agriculture sector has a long-term strategy focusing on food systems within each agro-climatic region per se, instead of a generalized food production strategy. The cornerstone of success in bringing about a more vibrant agricultural sector lies in upping agricultural R&D spending to at least 1% of agricultural GDP, thereby charting a trajectory of higher and inclusive growth, and making the national plan of doubling farmers' income in the near future possible.

CHAPTER 9

ALLIED SECTORS

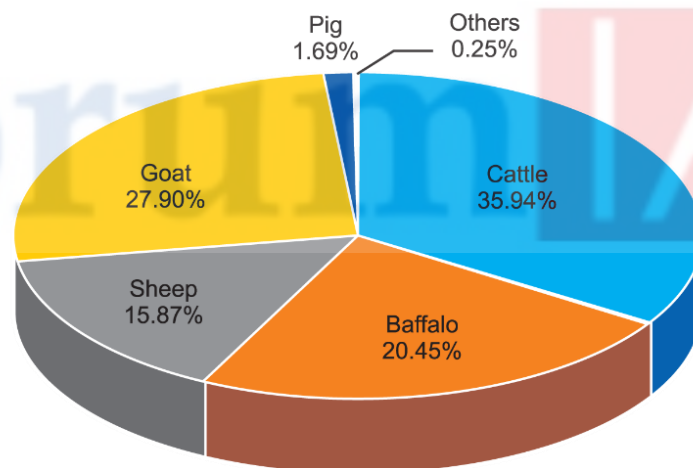
As per the NSSO 68th round survey, 16.44 million people are engaged in the activities of farming of animals, mixed farming, fishing, and aquaculture.

9.1 ANIMAL HUSBANDRY

Animal husbandry is the branch of science that deals with the practice of breeding, farming and care of farm animals such as cattle, dogs, sheep, and horses by humans for advantages. Animal husbandry refers to livestock raising and selective breeding. It is a branch of agriculture.

India is home to 535.78 million livestock population which has a potential to become sustainable livelihood for 90.2 million agricultural households. As the government is exploring means to raise farm incomes on a sustainable basis, livestock sector offers one such bright spot.

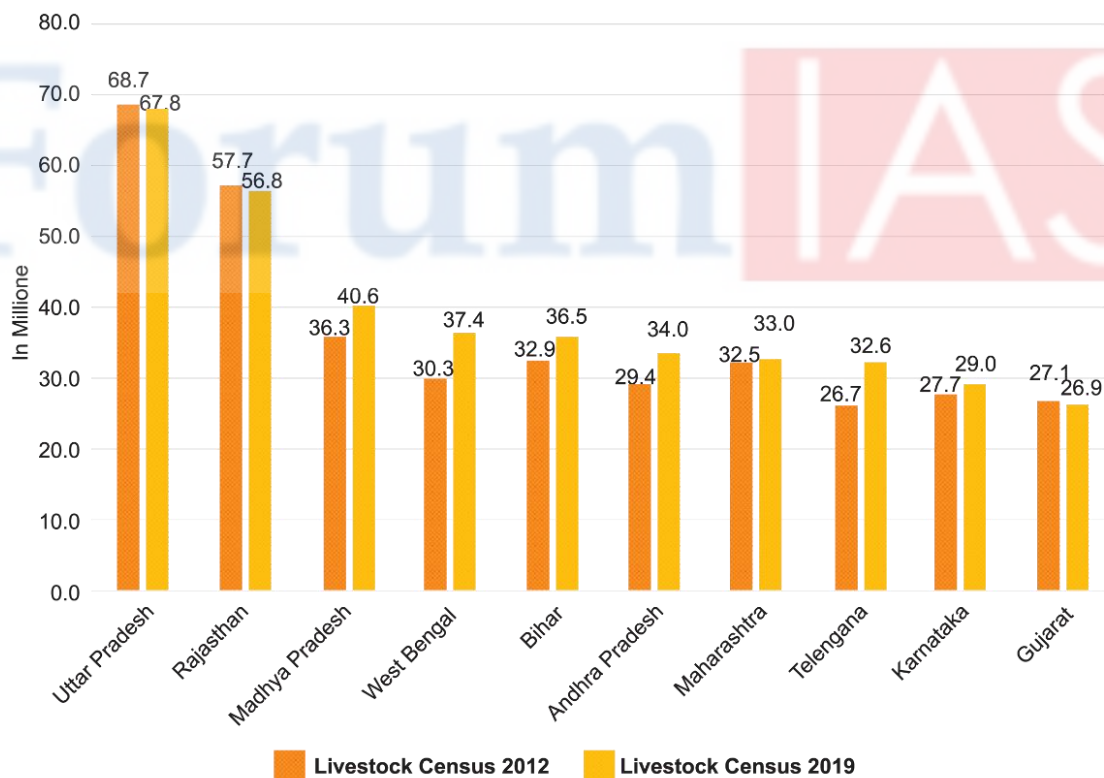
Department of Animal Husbandry conducts **Livestock Census** every 5 years since 1919-20. The 20th Livestock Census data was released recently which stated that India has the world's largest livestock population.



Livestock Population 2019- Share of Major Species

Category	Population (in Million) 2012	Population (In million) 2019	%growth
Cattle	190.90	192.49	0.83
Buffalo	108.70	109.85	1.06
Sheep	65.07	74.26	14.13
Goat	135.17	148.88	10.14
Pig	10.29	9.06	-12.03
Mithun	0.30	0.38	26.66
Yak	0.08	0.06	-25.00
Horses & Ponics	0.63	0.34	-45.68
Mule	0.20	0.08	-57.09
Donkey	0.32	0.12	-61.23
Camel	0.40	0.25	-37.05
Total Livestock	512.06	535.78	4.63

Livestock Population- Major Species



Livestock Population, 2012 and 2019 of Major States

1. The total Livestock population is 535.78 million in the country showing an increase of 4.6% over Livestock Census 2012.
2. Total Bovine population (Cattle, Buffalo, Mithun and Yak) is 302.79 million in 2019 which shows an increase of 1.0% over the previous census.
3. The total number of cattle in the country is 192.49 million in 2019 showing an increase of 0.8% over previous Census.

4. The Female Cattle (Cows population) is 145.12 million, increased by 18.0% over the previous census (2012).
5. The Exotic/Crossbred and Indigenous/Non-descript Cattle population in the country is 50.42 million and 142.11 million respectively.
6. The Indigenous/Non-descript female cattle population has increased by 10% in 2019 as compared to previous census.
7. The population of the total Exotic/Crossbred Cattle has increased by 26.9 % in 2019 as compared to previous census.
8. There is a decline of 6 % in the total Indigenous (both descript and non-descript) Cattle population over the previous census. However, the pace of decline of Indigenous Cattle population during 2012-2019 is much lesser as compared to 2007-12 which was about 9%.
9. The total buffaloes in the country are 109.85 million showing an increase of about 1.0% over previous Census.
10. The total milch animals (in-milk and dry) in cows and buffaloes is 125.34 million, an increase of 6.0 % over the previous census.
11. The total sheep in the country is 74.26 million in 2019, increased by 14.1% over previous Census.
12. The Goat population in the country in 2019 is 148.88 million showing an increase of 10.1% over the previous census.
13. The total Pigs in the country is 9.06 million in the current Census, declined by 12.03% over the previous Census.
14. The total Mithun in the country is 3.9 Lakhs in 2019, increased by 30.0% over previous Census.
15. The total Yak in the country is Fifty-Eight Thousand in 2019, decreased by 24.67% over previous Census.
16. The total Horses and Ponies in the country is 3.4 lakhs in 2019, decreased by 45.6% over previous Census.
17. The total population of Mules in the country is Eighty-Four Thousand in 2019, decreased by 57.1% over previous Census.
18. The total population of Donkeys in the country is 1.2 lakhs in 2019, decreased by 61.23% over previous Census.
19. The total Camel population in the country is 2.5 lakhs in 2019, decreased by 37.1% over previous Census.
20. The total Poultry in the country is 851.81 million in 2019, increased by 16.8% over previous Census.
21. The total Backyard Poultry in the country is 317.07 million in 2019, increased by 45.8% over previous Census.

Role of livestock in the Indian agriculture are as follows:

1. Sustainable agricultural development

1. The sector provides gainful employment to a large number of youngsters from rural areas and thus livestock as an allied sector can provide gainful employment, making farming a lucrative career opportunity.
2. Development in livestock sector can form a basis for the development of food processing sector.
3. Climate based agro-diversification will be the natural outcome of livestock related industry.

2. Food security

1. Protein and mineral rich nutritious diet due to milk, meat, egg, and fish.
2. Livestock are the best insurance against the vagaries of nature like drought, famines, and other natural disasters, thus never leaving a farmer with no resources to afford basic food needs.

3. Input functions

1. Livestock perform input functions like providing draught power (bulls/oxen), dung, urine, etc. in crop production.

However, the **livestock sector in India is marred with deficiencies** like:

1. Maize is a vital element of poultry feed, but its availability at a reasonable cost is a major problem of the poultry sector.
2. Pathogenic and emerging diseases like Foot and Mouth Diseases (FMDs), bird flu, and swine flu often cause major losses both in the domestic market and international trade.
3. There is an ominous need for realistic national marketing intelligence to bridge the gap between supply and demand of livestock and livestock products.
4. To fulfil the demand of sustainable and safe production, there is a massive demand for trained and skilled manpower in the livestock sector.
5. There is a non-availability of superior quality breeding livestock.
6. Livestock extension services are almost absent. Only 5.1% of the farm households were able to access any information on animal husbandry against 40.4% for crop farming.
7. Bulk of investment for livestock development comes from the state governments and there is hardly any private sector investment in animal husbandry.
8. Microbial contamination, antibiotic residues, and adulteration in milk, meat, and animal feed is rampant.

National Livestock Mission (NLM)

NLM launched in the financial year 2014-15 to ensure quantitative and qualitative improvement in livestock production systems and capacity building of all stakeholders. The scheme is being implemented as a sub-scheme of **White Revolution- Rashtriya Pashudhan Vikas Yojana**.

NLM has four Sub-Missions:

1. **Sub-Mission on Livestock Development:** It includes activities to address the concerns for overall development of livestock species including poultry, other than cattle and buffalo, with a holistic approach.
2. **Sub-Mission on Pig Development in North-Eastern Regions:** The sub-mission will strive to forge synergies of research and development organizations through appropriate interventions, as may be required for holistic development of pigs in the North-Eastern region including genetic improvement, health cover, and post-harvest operations.
3. **Sub-Mission on Feed and Fodder Development:** The sub-mission is designed to address problems of scarcity of animal feed and fodder resources, to give a push to the livestock

sector making it a competitive enterprise for India, and also to harness its export potential. The sub-mission will especially focus on increasing both production and productivity of fodder and feed through adoption of improved and appropriate technologies best suited to specific agro-climatic region in both arable and non-arable areas.

4. **Sub-Mission on Skill Development, Technology Transfer and Extension:** The sub-mission will provide a platform to develop, adopt or adapt the technologies including frontline field demonstrations in collaboration with farmers, researchers and extension workers, etc. wherever it is not possible to achieve this through existing arrangements.

National Animal Disease Control Programme (NADCP) aims to control livestock diseases, the foot and mouth disease (FMD) and brucellosis by 2025 and eradicate these by 2030.

Animal Husbandry Infrastructure Development Fund (AHIDF)

AHIDF, worth Rs. 15,000 crores was announced under **AtmaNirbhar Bharat Package**. It aims to increase the milk and meat processing capacity and product diversification, providing greater access to market, promote export and entrepreneurship, etc. It will facilitate investment in establishment of infrastructure for dairy and meat processing and value addition infrastructure and establishment of animal feed plant in the private sector. Eligible beneficiaries of the scheme include Farmer Producer Organizations (FPOs), MSMEs, not-for-profit companies, private companies and individual entrepreneurs.

Minimum 10% margin money is to be contributed by the beneficiary while the balance 90% would be the loan component to be made available by scheduled banks. Government of India will provide 3% interest subvention to eligible beneficiaries. Government will also set up a Credit Guarantee Fund of Rs. 750 crores to be managed by NABARD.

9.2 DAIRY

India ranks 1st in milk production, accounting for about 20% of the world's production. In the 1970s, **Operation Flood** was started as India's largest dairy development program and a landmark project of India's **National Dairy Development Board (NDDB)** with the objective of increasing milk production in India and setting up dairy farmers' cooperatives. As a result, the milk production has been rising steadily with All India per capita availability of milk at around 375 grams per day. The process has since been termed as the "**White Revolution**". White Revolution covers various other schemes like Dairy Entrepreneurship Development Scheme, Livestock Census, National Livestock Mission, Scheme for Fodder and Vaccination, etc.

National Programme for Bovine Breeding and Dairy Development (NPBB&DD)

The NPBB&DD has been formulated by merging four ongoing schemes of the Department of Animal Husbandry, Dairying and Fisheries in the dairy sector. These are the National Project for Cattle and Buffalo Breeding (NPCBB), Intensive Dairy Development Program (IDDP), Strengthening Infrastructure for Quality and Clean Milk Production (SIQ and CMP), and assistance to cooperatives. This has been done to integrate milk production and dairying activities in a scientific and holistic manner for attaining higher levels of milk production and productivity, to meet the increasing demand for milk in the country.

NPBB&DD has the following three components:

1. National Program for Bovine Breeding (NPBB)

1. To arrange artificial insemination services at farmers' doorsteps.
2. To bring all breedable females under organized breeding through artificial insemination or natural service using germplasm of high genetic merits.
3. To conserve, develop, and proliferate selected indigenous bovine breeds of high socio-economic importance.
4. To provide quality breeding inputs in breeding tracts of important indigenous breeds so as to prevent the breeds from deterioration and extinction.

2. National Program for Dairy Development (NPDD)

1. To create and strengthen infrastructure for production of quality milk including cold chain infrastructure linking the farmer to the consumer.
2. To create and strengthen infrastructure for procurement, processing, and marketing of milk and milk products.
3. To create training infrastructure for training of dairy farmers.
4. To strengthen dairy cooperative societies/producer companies at village level.
5. To increase milk production by providing technical input services like cattle-feed, and manure mixture, etc.
6. To assist in rehabilitation of potentially viable milk federations/union.

- 3. Rashtriya Gokul Mission:** It aims to conserve and increase the population of indigenous bovine breeds (Gir, Sahiwal, Rathi, Deoni, Red Sindhi, and Tharpakar). Other objectives of the mission include increasing milk production and productivity, upgradation of non-descript cattle using elite indigenous breeds, and distribution of disease free high genetic merit bulls for natural service.

National Mission on Bovine Productivity (NMBP)

NMBP will be implemented as a part of Rashtriya Gokul Mission under umbrella scheme **White Revolution- Rashtriya Pashudhan Vikas Yojana**. The objectives of the mission are to enhance milk production and productivity of bovine population, increase trade of livestock and its products, e-market for bovine germplasm, and to double farmers' income by 2022.

The mission has four components- Pashudhan Sanjivani, e-Pashudhan Haat portal, advanced breeding technology [like In-Vitro Fertilization (IVF)/Multiple-Ovulation Embryo Transplant (MOET)], and National Bovine Genomic Centre for Indigenous Breeds (NBGC-IB).

Notable parts of the White Revolution are:

1. **National Kamdhenu Breeding Centre:** It has been established under Rashtriya Gokul Mission for the development and conservation of indigenous breeds in a scientific manner.
2. **Rashtriya Kamdhenu Aayog 2019:** It is an executive body set up in the Department of Animal Husbandry & Dairying. The Aayog aims to enhance cow productivity through research in

organic manure, biogas, etc. and also bring about genetic up-gradation of cow resources. Cow welfare and cow protection laws also comes under its ambit.

3. **Pashudhan Sanjivani:** It is an animal wellness programme under which farmers are given Nakul Swastha Patra which is an animal health card with UID identification number of each animal registered in a national database.
4. **e-Pashudhan Haat Portal:** It is an online portal for connecting farmers with breeders of indigenous bovine breeds so that they can connect with each other for artificial insemination, indigenous breeds, etc.

National Dairy Plan (NDP)

NDP is a central sector scheme being implemented by the National Dairy Development Board (NDDB) through the network of End Implementing Agencies (EIAs) for the period 2011-12 to 2018-19. It is a scientifically planned multi-state initiative to increase the productivity of milch animals and thereby increase milk production through scientific breeding and feeding and to provide rural milk producers with greater access to the organized milk processing sector.

Dairy Entrepreneurship Development Scheme

The scheme was started in September, 2010 with the objective to generate self-employment opportunities in the dairy sector in the country. The scheme is being implemented through NABARD which provides financial assistance to commercially bankable projects with loans from commercial, cooperative, urban, and rural banks with a bank ended capital subsidy of 25% of the project cost to the beneficiaries of general category and 33.33% of the project cost to SC & ST beneficiaries.

Dairy Processing and Infrastructure Development Fund (DIDF)

To ensure that the dairy cooperatives remain competitive for the sustained benefit of farmers, the Government of India had created DIDF under NABARD with a corpus of Rs. 8000 crores over a period of 3 years (i.e., 2017-18 to 2019-20). Funding will be in the form of interest-bearing loan, which will flow from NABARD to NDDB/National Cooperative Development Cooperation (NCDC) and in turn to eligible end borrowers.

National Dairy Development Board (NDDB)

The NDDB is an institution of national importance set up by an Act of Parliament. The main office is in Anand, Gujarat with regional offices throughout the country. The board was created to finance and support producer owned and controlled organizations. Its programme and activities seek to strengthen farmer cooperatives and support national policies that are favourable to the growth of such institutions. Cooperative principles and cooperative strategies are fundamental to the board's efforts.

The end borrowers of the scheme are milk unions, state dairy federations, multi-state milk cooperatives, milk producer companies, and NDDB subsidiaries meeting the eligibility criteria under the project. The loan component would be 80% (maximum) and the end borrower's contribution would be 20% (minimum). The end borrowers would get the loan @6.5% per annum and the period of repayment would be 10 years with initial two years moratorium.

While the Operation Flood was a success, it's high time that **we move towards achieving a Second White Revolution** to overcome supply side and demand side challenges.

1. **Supply side challenges** include the subsidiary nature of dairy farming, stagnant yields, rising feed and fodder costs, and a shift in rural areas towards other occupations.
2. **Demand side challenges** due to booming population and the fact that current levels of yield would not be able to cope up with the rising demand.

For achieving Second White Revolution, steps which can be undertaken include:

1. Setting up large scale dairy farms.
2. Developing community ownership and management of common infrastructure for housing, breeding, feeding and milking under a cooperative/producer company model.
3. Genetic improvement of indigenous breeds.
4. Providing technical support like veterinary care, feed management, and training to the livestock farmers.
5. Providing cheap credit to the dairy farmers so that they can invest in the latest technologies like artificial insemination.
6. **Economic Survey 2019 recommends that farmers should focus on 'small ruminants'** (sheep and goats) as they higher survival rates under drought conditions compared to bovines and can even live on shrubs and trees.

9.3 FISHERIES SECTOR

India is the **second largest fish producer** in the world and the majority of our production comes from inland fisheries sector. Fisheries sector provides employment (around 14.5 million people), income and livelihood to poor fishermen, export opportunities, and nutrition to a large section of our population.

However, **the fisheries sector faces a number of challenges in India** like:

1. **Indiscriminate fishing** leading to a decline in fish population.
2. **Climate change** and associated negative environmental consequences along with water pollution has led to a severe loss of fish habitats (e.g., bleaching of coral reefs).
3. **Inadequate supply** of seed, feed, and genetic resources.
4. **Limited private sector investment** in this sector.
5. **Inadequate cold storage infrastructure** necessary to preserve and increase shelf-life of fishes.
6. **Lack of a reliable database** relating to aquatic and fisheries resources.
7. Weak marketing and extension network.
8. **Weak linkages** between R&D and fish farmer community leading to a limited number of species grown/cultured.
9. **Old technology** like use of traditional vessels instead of motorized fishing vessels have led to low catch rates.

To overcome the above challenges, Department of Fisheries has initiated "**Blue Revolution**" for tapping the full potential of the inland and marine culture fisheries of the country by developing it as a professional modern world class industry. **Objectives of Blue Revolution** include:

1. To fully tap the total fish potential of the country both in the inland and the marine sector and **triple the production by 2020.**

2. To transform the fisheries sector as a modern industry with special focus on **new technologies and processes**.
3. To double the income of the fishers and fish farmers with special focus on **increasing productivity and better marketing post-harvest infrastructure** including e-commerce and other technologies and global best innovations
4. To ensure **inclusive participation** of the fishers and fish farmers in the income enhancement
5. To **triple the export earnings** by 2020 with focus on benefits flow to the fishers and fish farmers including through institutional mechanisms in the cooperative, producer companies and other structures
6. To enhance food and nutritional security of the country

The Ministry of Agriculture and Farmers' Welfare, Department of Animal Husbandry, Dairying & Fisheries has restructured the scheme by merging all the ongoing schemes under an umbrella of Blue Revolution. The restructured scheme provides focused development and management of fisheries, covering inland fisheries, aquaculture, marine fisheries including deep sea fishing, mariculture and all activities undertaken by the National Fisheries Development Board (NFDB).

The Blue Revolution scheme has the following components:

1. National Fisheries Development Board (NFDB) and its activities
2. Development of Inland Fisheries and Aquaculture
3. Development of Marine Fisheries, Infrastructure and Post-Harvest Operations
4. Strengthening of Database & Geographical Information System of the Fisheries Sector
5. Institutional Arrangement for Fisheries Sector
6. Monitoring, Control and Surveillance (MCS) and other need-based Intervention
7. National Scheme of Welfare of Fishermen.

National Policy on Marine Fishery, 2017

The policy intends to guide the coordination and management of marine fisheries in the country during the next 10 years. It envisions to create a healthy and active marine fishery sector which can fulfill the necessities of present and future generations.

The policy states that “private investments will be promoted in deep sea fishing and processing to fully harness the potential of marine fishery for inclusive development. Sustainable utilization of the deep-sea fisheries resources necessitates an optimal fleet size of modern fishing vessels capable of undertaking extended voyages, and wherever required, support of overseas technology will also be considered for the development of the sector”.

Legislations will be brought to economically empower the producer cooperatives and the right of first sale option to be given to the fishermen.

Fisheries and Aquaculture Infrastructure Development Fund (FIDF)

FIDF envisages creation of fisheries infrastructure facilities both in marine and inland fisheries sectors and augment the fish production to achieve the target of 15 million tonnes by 2020 set under the Blue Revolution. It provides concessional finance to the eligible entities, cooperatives, individuals, and entrepreneurs for development of identified fisheries infrastructure.

NABARD, NCDC, and all scheduled banks are Nodal Loaning Entities (NLEs) will provide concessional finance under the FIDF. The Department of Fisheries, Ministry of Fisheries, Animal Husbandry and Dairying under FIDF provides interest subvention up to 3% per annum for providing the concessional finance by the NLEs at the interest rate not lower than 5% per annum.

Owing to its massive coastline of over 8,000 km and a vast network of rivers, fisheries have always played a significant role in India's economy. Despite its potential, this is a sector with untapped potential. However Blue Revolution will enable us to realize the vision of the Prime minister to double our fish production, transforming Matsya Sampada with Matsya Samridhi by creating wealth and prosperity in the fishing community.

9.4 MISCELLANEOUS

National Beekeeping and Honey Mission (NBHM) is a central sector scheme for overall promotion and development of scientific beekeeping and production of quality honey and other beehive products. It was launched considering importance of beekeeping and to achieve goal of Sweet Revolution. Currently, India ranks 8th in the world in terms of honey production.

The **mission has three components:**

1. Production and productivity improvement of various crops through pollination.
2. Post-harvest management of beekeeping/beehive products.
3. Research and technology generation for different agro-climatic and socio-economic conditions.

Under this, National Bee Board has trained 30 lakh farmers in beekeeping.

CHAPTER 10

MISCELLANEOUS

The **International Treaty on Plant Genetic Resources for Food and Agriculture**, also known as **Seed Treaty**, aims at guaranteeing food security through conservation, exchange and sustainable use of world's plant genetic resources for food and agriculture. It was adopted by the 31st session of the Conference of Food and Agricultural Organization (FAO) of the UN in 2001.

Climate Change and Agriculture have become interlinked in recent times. Agriculture in India continues to be vulnerable to the vagaries of weather because close to 52% (73.2 million hectares area of 141.4 million hectares net sown area) of it is still un-irrigated and rainfed. Crops grown in rainfed areas-pulses in both rabi and kharif- are vulnerable to weather shocks.

	Extreme Temperature Shocks	Extreme Rainfall Shocks
Average Kharif	4.0%	12.8%
Kharif, Irrigated	2.7%	6.2%
Kharif, Unirrigated	7.0%	14.7%
Average Rabi	4.7%	6.7%
Rabi, Irrigated	3.0%	4.1%
Rabi, Unirrigated	7.6%	8.6%

*Impact of Weather Shocks on Agricultural Yields (percentage decline
In response to temperature rise and rainfall decrease)*

Source- Economic Survey

	Extreme Temperature Shocks	Extreme Rainfall Shocks
Average Kharif	4.3%	13.7%
Kharif, Irrigated	7.0%	7.0%
Kharif, Unirrigated	5.1%	14.3%
Average Rabi	4.1%	5.5%
Rabi, Irrigated	3.2%	4.0%
Rabi, Unirrigated	5.9%	6.6%

Impact of Weather Shocks on Farm Revenue

Source- Economic Survey

Extreme weather events also negatively impact farmer incomes. Here again, the largest adverse effects of weather shocks are being felt in unirrigated areas. Yield decreases due to supply shock leading to a reduction in revenues.

To address the threats from climate change on Indian agriculture, **Economic Survey 2017-18 recommends the following policy changes:**

1. It is vital to make a **clear distinction between two agricultures in India**: a) cereals grown in Northern India- the well irrigated, input-added, and price-and-procurement- supported, where the challenge is for policy to change the form of the very generous support from prices and subsidies to less damaging support in the form of direct benefit transfer, and b) non-cereals in central, western, and southern India- inadequate irrigation, continued rain dependence, ineffective procurement, and insufficient investments in research and technology (non-cereals such as pulses, soyabeans, and cotton), high market barriers and weak post-harvest infrastructure (fruits and vegetables), and challenging non-economic policy (livestock).
2. India needs to **expand irrigation**, especially in the backdrop of rising water scarcity and depleting groundwater resources. Technologies like drip irrigation, sprinklers should be adopted to further the campaign “more crop for every drop”. Further, power subsidy should be replaced by direct benefit transfer so that power use can be fully accounted for and water conservation furthered.
3. **Embracing agricultural science and technology** is the need of the hour. It will not only improve yields but also increase resilience to all the pathologies that climate change threatens to bring in its wake like pests and crop diseases.
4. Building on the current crop insurance program (Pradhan Mantri Fasal Bima Yojana), weather based models and technologies (drones) need to be used to **determine losses and compensate farmers**.

Climate-Smart Agriculture (CSA) is another means to cope up with the increasing vagaries of climate change. It involves farming practices that improve farm productivity and profitability, help farmers to adapt to the negative effects of climate change and mitigate climate change effects.

Global Alliance for Climate Smart Agriculture (GACSA) was launched in September 2014 as a multi-stakeholder platform on Climate Smart Agriculture. India though a signatory of the alliance was not involved in its creation.

Examples of Climate Smart Agriculture include:

1. Increasing the organic content of soil through conservation tillage.
2. Engaging in Conservation Agriculture like adopting minimum tillage, using crop residues to cover soil surface and adopting crop rotations.
3. Following a landscape approach in agriculture, like integrated planning of land.

Adaptation for Smallholder Agriculture Program is administered by the International Fund for Agricultural Development (IFAD). The Program aims to channel climate and environmental finance to small-holder farmers, scale up climate change adaptation in rural development programmes and mainstream climate adaptation into IFAD's work.

International Years by the United Nations are:

1. 2016 had been declared as the “**International Year of Pulses**”.
2. 2020 had been declared as the “**International Year of Plant Health**”.
3. 2022 has been declared as the “**International Year of Artisanal Fisheries and Aquaculture**”.
4. 2023 has been declared as the “**International Year of Millets**”.

List of agricultural revolutions in India:

1. **Yellow Revolution** aimed at increasing oilseed production (especially mustard and sunflower).
2. **Blue Revolution** aimed at increasing fish production.
3. **Golden Fiber Revolution** aimed at increasing jute production.
4. **Golden Revolution** aimed at increasing fruits/honey/horticulture production.
5. **Silver Revolution** aimed at increasing egg production.
6. **Grey Revolution** is related to increased fertilizer production.
7. **Brown Revolution** is aimed at meeting the demand for coffee from developed nations by growing socially responsible and environment friendly coffee.
8. **Pink Revolution** aimed at increasing the production and export of meat in India.

Geographical Indication (GI) is an important tool for protecting Intellectual Property (IP) rights associated with agricultural products and foodstuffs originating in specific geographical regions.

Important GI tags in agriculture are as follows:

1. **Kashmir Saffron** (Jammu & Kashmir)
2. **Manipuri Black Rice** (Manipur)
3. **Gobindabhog Rice** (West Bengal)
4. **Darjeeling Tea** (West Bengal)
5. **Bikaneri Bhujia** (Rajasthan)
6. **Kandhamal Haladi** (Odisha)
7. **Kodaikanal Malai Poondu** (Tamil Nadu)
8. **Palani Panchamirtham** (Tamil Nadu)
9. **Gulbarga Tur Dal** (Karnataka)

AGMARK is a certification mark approved by Directorate of Marketing and Inspection and legally enforced by Agricultural Produce (Grading and Marketing) Act of 1937 (amended in 1986). It assures conformity to a set of standards.

The present AGMARK standards cover quality guidelines for 205 different commodities spanning variety of cereals, pulses, vegetable oils, essential oils, fruits & vegetables, and semi-processed products.

The Centre is in the process of creating for the first time a “**digital agri-stack**”, a hi-tech national farmers’ database that could give the government and agribusinesses unprecedented insights into the rural economy. Under the programme, each farmer of the country will get FID, or a farmers’ ID, linked to land records to uniquely identify them. The database uses Aadhar-based data generated from key farm sector programmes such as PM-KISAN and is being built under the National e-Governance Plan in agriculture.

The digital repository will **aid precise targeting of subsidies, including fertilizers, cheap crop insurance and dissemination of mobile-based crop advisories**. A unified farmers’ database will help digitize agricultural services delivery by the public and private sectors. The database will connect seemingly simple data points: the number of occupational farmers who avail of subsidies, how much land they own, what they grow and which agro-climatic zones they fall in. This data can be further monetized.

However, the **new digital push in agriculture raises serious concerns**. These concerns are about information asymmetry, data privacy and consent, profiling of farmers, mismanaged of land records, and corporatization (as farmers' data would be shared with private companies).

South Asian Association for Regional Cooperation (SAARC) countries signed the agreement to establish the **SAARC Food Bank**. The Food Bank will help member nations' people in case of emergencies. Each member country is required to contribute either wheat or rice and the stock is to be kept with respective government agencies.

International Grains Council (IGC) is headquartered at London and aims to foster cooperation in wheat and coarse grain matters. Both importing and exporting countries are its members with India being included in the category of exporting member since 2003.

Food and Agriculture Organization (FAO) is a specialized agency of the United Nations (UN), set up in 1945 with its headquarters at Rome, Italy. FAO published its report, "**The State of Food Security and Nutrition in the World 2020**" which spotlights the links between food security and nutrition.

The Food and Agricultural Organization (FAO) recognizes **GIAHS (Globally Important Agricultural Heritage Systems)** as "remarkable land use systems and landscapes which are rich in globally significant biological diversity evolving from the co-adaptation of a community with its environment and its needs and aspirations or sustainable development".

India has two GIAHS as recognized by FAO:

1. Traditional Agricultural System, Koraput, Odisha
2. Below Sea Level Farming System, Kuttanad, Kerala

Vertical farming is the practice of growing crops in vertically stacked layers. It often incorporates controlled-environment agriculture, which aims to optimize plant growth, and soilless farming techniques like hydroponics, aquaponics, and aeroponics. Vertical farming uses significantly less water and pesticides than traditional agricultural methods.

Biochar is a stable, carbon-rich form of charcoal that is applied to soil. Biochar from manures and food wastes have higher levels of nitrogen and phosphorus. It offers several advantages like increasing soil fertility, water holding capacity, and crop productivity.

In India, cluster bean (**Guar**) is traditionally used as a vegetable or animal feed, but recently the cultivation of this has assumed significance. It is now **widely used in oil and gas well drilling** due to its multi-function such as fluid and water-loss control, lubrication and cooling of drill bits, shale inhibitor and solids carrier. It has excellent solution rheology, stability, solubility, and compatibility with other auxiliaries used in oil well drilling.

Biofuels are any hydrocarbon fuel that is produced from organic matter in a short period of time. It may be categorized as follows:

1. **First Generation (1G) biofuels:** It uses food crops like wheat for making ethanol.
2. **Second Generation (2G) biofuel:** It uses non-food crops like wood, grass, organic waste.
3. **Third Generation (3G) biofuel:** It uses specially engineered algae.

4. **Fourth Generation biofuel:** It aims at only producing sustainable energy but also a way of capturing and storing CO₂.

However, biofuel adoption in India remains low due to the following reasons:

1. Setting up engineered algae-based biofuel production requires high level of expertise/technology until construction is completed.
2. Economically viable production necessitates the setting up of large-scale facilities which may raise ecological and social concerns.

Keeping in mind the above challenges, Ministry of New and Renewable Energy (MNRE) released the **National Policy on Biofuels, 2018**. Its major points include:

1. It **categorizes biofuels** into:
 1. Basic Biofuels: First Generation (1G) bioethanol and biodiesel.
 2. Advanced Biofuels: Second Generation (2G) ethanol, Municipal Solid Waste (MSW) to drop-in fuels, Third Generation (3G) biofuels, bio-CNG, etc.
2. **Viability Gap Funding (VGF)** scheme for 2G ethanol bio refineries.
3. **Expands the scope of raw materials** for ethanol production by allowing use of sugarcane juice, sugar containing materials like sugar beet, starch containing materials like corn and cassava, damaged food grains like wheat and rotten potatoes unfit for human consumption.
4. **Allows use of surplus food grains** for production of ethanol. However, it needs the approval of National Biofuel Coordination Committee headed by the Minister, Petroleum and Natural Gas.

Tensiometers are sealed, water filled tube with a ceramic porous cup and a vacuum gauge at the top. Its use can be helpful in providing estimates of soil moisture as one could save huge quantities of water and energy by knowing when and how much water is required by a crop, thereby promoting eco-friendly agriculture.

Transplantation is the process in which plant is grown in other places by replacing it from its original place. It enables selective cultivation of healthy seedling which results in better crop production. There is better root penetration into the soil and improved shoot development. However, many transplanted seedlings do not grow **because most of the root hairs are lost during the process**.

Vegetative propagation is any form of asexual reproduction occurring in plants in which a new plant grows from a fragment of the parent plant or a specialized reproductive structure. This can occur through fragmentation and regeneration of specific vegetative parts of plants. Many plants naturally reproduce this way, but it can also be induced artificially. **Vegetative propagation can be practiced most of the year and produces clonal population.**

Genome sequencing is the sequencing of bases in DNA that determines the genetic information of a given organism. Learning about the DNA sequences can lead to an understanding of their natural capacities that can be applied towards solving challenges in health care, agriculture, energy production, and environmental remediation.

Genome sequencing can be used to **identify genetic markers** for disease resistance and drought tolerance in various crop plants. It will **reduce the time required** to develop new varieties of crop plants. This technique can also be used to **decipher the host-pathogen relationships** in crops.