11. Current scenario of Indian agriculture

1. Organic Farming

**Organic farming** is an alternative agricultural system which originated early in the 20th century in reaction to rapidly changing farming practices. It relies on fertilizers of organic origin such as compost, manure, green manure, and bone meal and places emphasis on techniques such as crop rotation and companion planting. Biological pest control, mixed cropping and the fostering of insect predators are encouraged. In general, organic standards are designed to allow the use of naturally occurring substances while prohibiting or strictly limiting synthetic substances. For instance, naturally occurring pesticides such as pyrethrin and rotenone are permitted, while synthetic fertilizers and pesticides are generally prohibited. Synthetic substances that are allowed include, for example, copper sulfate, elemental sulfur and Ivermectin. Genetically modified organisms, nanomaterials, human sewage sludge, plant growth regulators, hormones, and antibiotic use in livestock husbandry are prohibited. Organic agricultural methods are internationally regulated and legally enforced by many nations, based in large part on the standards set by the International Federation of Organic Agriculture Movements (IFOAM), an international umbrella organization for organic farming organizations established in 1972.

“Organic agriculture can be defined as: an integrated farming system that strives for sustainability, the enhancement of soil fertility and biological diversity whilst, with rare exceptions, prohibiting synthetic pesticides, antibiotics, synthetic fertilizers, genetically modified organisms, and growth hormones”.

2. Farming system, Definition

Farming system is a resource management strategy to achieve economic and sustained agricultural production to meet diverse requirements of farm livelihood while preserving resource base and maintaining a high level of environment quality (Lal and Miller 1990).

**Key principles**

- **Cyclic** The farming system is essentially cyclic (organic resources – livestock – land – crops). Therefore, management decisions related to one component may affect the others.
Rational Using crop residues more rationally is an important route out of poverty. For resource-poor farmers, the correct management of crop residues, together with an optimal allocation of scarce resources, leads to sustainable production.

Ecologically sustainable Combining ecological sustainability and economic viability, the integrated livestock-farming system maintains and improves agricultural productivity while also reducing negative environmental impacts.

Benefits or Advantages of Integrated Farming System
1) Productivity
2) Profitability
3) Potentiality or Sustainability
4) Balanced Food
5) Environmental Safety
6) Recycling
7) Income Rounds the year
8) Adoption of New Technology
9) Saving Energy
10) Meeting Fodder crisis
11) Solving Fuel and Timber Crisis
12) Employment Generation
13) Agro – industries
14) Increasing Input Efficiency

3. Precision Farming
Precision agriculture (PA) or satellite farming or site specific crop management (SSCM) is a farming management concept based on observing, measuring and responding to inter and intra-field variability in crops.

Precision agriculture aims to optimize field-level management with regard to:
- Crop science: matching farming practices closely to crop needs (e.g. fertilizer inputs);
- Environmental protection: reducing environmental risks (e.g. limiting leaching of nitrogen);
- Economics: boosting competitiveness through more efficient practices (e.g. improved management of fertilizer usage and other inputs).

Precision agriculture also provides farmers with a wealth of information to:
• build up a record of their farm;
• improve decision-making;
• foster greater traceability
• enhance marketing of farm products
• improve lease arrangements and relationship with landlords
• enhance the inherent quality of farm products (e.g. protein level in bread-flour wheat)

Emerging technologies

Robots
Self-steering tractors have existed for some time now, as John Deere equipment works like a plane on autopilot. Technology is advancing towards driverless machinery programmed by GPS to spread fertilizer or plow land. Agricultural robots, also known as AgBots, already exist, but advanced harvesting robots are being developed to identify ripe fruits, adjust to their shape and size, and carefully pluck them from branches.

Drones and satellite imagery
Advances in drone and satellite technology benefits precision farming because drones take high quality images, while satellites capture the bigger picture. Light aircraft pilots can combine aerial photography with data from satellite records to predict future yields based on the current level of field biomass. Aggregated images can create contour maps to track where water flows, determine variable-rate seeding, and create yield maps of areas that were more or less productive.

The Internet of things
The Internet of things is the network of physical objects outfitted with electronics that enable data collection and aggregation. For example, farmers can spectroscopically measure nitrogen, phosphorus, and potassium in liquid manure, which is notoriously inconsistent.\footnote{[21]} They can then scan the ground to see where cows have already urinated and apply fertilizer to only the spots that need it. This cuts fertilizer use by up to 30%.

4. Micro irrigation

Definition of Micro Irrigation:

It can be defined as the application of water at low volume and frequent interval under low pressure to plant root zone.

Besides the land, water also an important factor in the progress of Agriculture. In vast country like India with a geographical area of 328 million hectares less than 45% area is cultivated of this cultivated area only 35% i.e. 65 million ha gets irrigation. This could be
achieved by introducing advanced and sophisticated methods of irrigation viz. drip irrigation, sprinkler, etc.

**Micro-sprayers/sprinklers** is installed on a stake, wetting foliage and a larger surface area of 4-6 feet.

**Micro-bubblers** are installed on short stakes, have solid spray and used to establish and maintain larger plants and have less evaporation than micro-sprayers/sprinklers.

**Drippers** apply water directly to the soil resulting in minimal evaporation, attach to a distribution tube or spaghetti tubing and are used for widely spaced plants or containers.

**Drip tubing** contains factory installed emitters inside the tubing that are pressure compensating, and has fewer parts/pieces than other types of microirrigation.

### 5. Conservation Agriculture

**Definition of Conservation Agriculture**

It is a way of farming that conserves, improves and makes more efficient use of natural resources through integrated management of available resources combined with external inputs. It contributes to environmental conservation as well as to enhanced and sustain agricultural production. It can also be referred to as resource efficient agriculture.

Conservation agriculture has three basic principles:

1. Disturb the soil as little as possible: farmers plough and hoe to improve the soil structure and control weeds. But in the long term, they actually destroy the soil structure and contribute to declining soil fertility.
2. Mulching: cover crops protect the soil from erosion and limit weed growth throughout the year.
3. Mix and rotate crops with legume based cropping system

### 6. Nanotechnology

It deals with the physical, chemical, and biological properties of matter considered at nanoscale (1–100 nm) and their implications for the welfare of human beings. Nanomaterial is an ingredient containing particles with at least one dimension that approximately measures 1–100 nm. It has the ability to control and/or manufacture matter at this scale which results in
the development of innovative and novel properties like increase in the surface area of the particles that can be utilized to address numerous technical and societal issues.

**Table 1: Classification of nanomaterials.**

<table>
<thead>
<tr>
<th>Categories of nanomaterials</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nanoparticles</td>
<td>Submicron or even ultramicron size particles obtainable as high performance radiant resistant materials, magnetic materials, solar battery materials, packaging materials, and magnetic fluid materials</td>
</tr>
<tr>
<td>Nanotubes and nanofibers</td>
<td>Nanometer size long linear material, optical materials, micro conductors, microfibers, nanotubes of PEEK, PET and PTFE</td>
</tr>
<tr>
<td>Nanofilm</td>
<td>Films utilized as gas catalyst materials</td>
</tr>
<tr>
<td>Nanoblock</td>
<td>Nanometer crystalline materials produced by substantial accuracy, developing controlled crystallization or nanoparticles</td>
</tr>
<tr>
<td>Nanocomposites</td>
<td>Composite nanomaterials, which use nanosize reinforcements instead of conventional fibers or particulates</td>
</tr>
<tr>
<td>Nanocrystalline solids</td>
<td>Polycrystals with the size of 1 to 10 nm and 50% or more of solid consists of inherent interface between crystals and different orientations. The clusters that formed through homogenous nucleation and grow by coalescence and incorporation of atoms</td>
</tr>
</tbody>
</table>
Table 2: Commercial uses of nanoparticles

<table>
<thead>
<tr>
<th>Type of product</th>
<th>Product name &amp; manufacturer</th>
<th>Nano content</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nano-agrochemicals</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Super” combined fertilizer and pesticide</td>
<td>Pakistan-US Science and Technology Cooperative Program</td>
<td>Nano-clay capsule contains growth stimulants and biocontrol agents</td>
<td>Slow release of active ingredients, Reducing application rates</td>
</tr>
<tr>
<td>Herbicide</td>
<td>Tamil Nadu Agricultural University (India) and Technologico de Monterry (Mexico)</td>
<td>Nano-formulated</td>
<td>Designed to attack the seed coat of weeds, destroy soil seed banks and prevent weed germination</td>
</tr>
<tr>
<td>Pesticides, including herbicides</td>
<td>Australian Common wealth Scientific and Industrial Research Organization</td>
<td>Nano-encapsulated active ingredients</td>
<td>Very small size of nanocapsules increases their potency and may enable targeted release of active ingredients</td>
</tr>
<tr>
<td><strong>Nano-materials</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutritional supplement</td>
<td>Nanoceuticals ‘mycrohydrin’ powder, RBC Life sciences</td>
<td>Molecularcaes 1-5 nm diameter made from silica mineral hydride comple</td>
<td>Nano-sized mycrohydrin has increased potency and bioavailability. Exposure to moisture releases H- ions and acts as a powerful antioxidant.</td>
</tr>
<tr>
<td>Nutritional drink</td>
<td>Oat Chocolate Nutritional Drink Mix, Toddler Health</td>
<td>300nm particles of iron (SunActive Fe)</td>
<td>Nano-sized iron particles have increased reactivity and bioavailability.</td>
</tr>
<tr>
<td>Food packaging</td>
<td>Adhesive for McDonald’s burger containers, Ecosynthetix</td>
<td>50-150nm starch nanospheres</td>
<td>These nanoparticles have 400 times the surface area of natural starch particles. When used as an adhesive they require less water and thus less time and energy to dry.</td>
</tr>
<tr>
<td>Food additive</td>
<td>Aquasol preservative, AquaNova</td>
<td>Nanoscale micelle (capsule) of lipophilic or water insoluble substances</td>
<td>Surrounding active ingredients within soluble nanocapsules increases absorption within the body (including individual cell)</td>
</tr>
<tr>
<td>Plant growth treatment</td>
<td>Primo Maxx, Syngenta</td>
<td>100nm particle size emulsion</td>
<td>Nano-sized particles increases the potency of active ingredients, potentially reducing the quantity to be applied</td>
</tr>
</tbody>
</table>

**Place of Indian Agriculture in Indian Economy**

*The agriculture sector employs nearly half of the workforce in the country. However, it contributes to 17.5 % of the GDP (at current prices in 2015-16).*
Over the past few decades, the manufacturing and services sectors have increasingly contributed to the growth of the economy, while the agriculture sector’s contribution has decreased from more than 50% of GDP in the 1950s to 15.4% in 2015-16.

India’s production of food grains has been increasing every year and India is among the top producers of several crops such as wheat, rice, pulses, sugarcane and cotton. It is the highest producer of milk and second highest producer of fruits and vegetables.

In 2013, India contributed 25% to the world’s pulses production, the highest for any one country, 22% to the rice production and 13% to the wheat production. It also accounted for about 25% of the total quantity of cotton produced, besides being the second highest exporter of cotton for the past several years. However, the agricultural yield (quantity of a crop produced per unit of land) is found to be lower in the case of most crops, as compared to other top producing countries such as China, Brazil and the United States.

Agricultural growth has been fairly volatile over the past decade, ranging from 5.8% in 2005-06 to 0.4% in 2009-10 and -0.2% in 2014-15.

Total production of food grains increased from 51 million tonnes in 1950-51 to 252 million tonnes in 2015-16.

According to the second advance estimate by the Ministry of Agriculture, food grains production is estimated to be 272 million tonnes in 2016-17.

The production of wheat and rice took off after the green revolution in the 1960s, and as of 2015-16, wheat and rice accounted for 78% of the food grains production in the country.

Importance Of Agriculture

Agriculture plays a crucial role in the life of an economy. It is the backbone of our economic system. Agriculture not only provides food and raw material but also employment opportunities to a very large proportion of population. The following facts clearly highlight the importance of agriculture in this country.

1. Source of Livelihood: In India the main occupation of our working population is agriculture. About 70 per cent of our population is directly engaged in agriculture. In advanced countries, this ratio is very small being 5 per cent in U.K., 4 per cent in USA., 16 per cent in Australia, 14 per cent in France, 21 per cent in Japan and 32 per cent in USSR.

2. Contribution to National Income: Agriculture is the premier source of our national income. According to National Income Committee and C.S.O., in 1960-61, 52 per cent of national
income was contributed by agriculture and allied occupations. This was further reduced to 28 per cent in 1999-2000.

3. Supply of Food and Fodder: Agriculture sector also provides fodder for livestock (35.33 crores). Cow and buffalo provide protective food in the form of milk and they also provide draught power for farm operations. Moreover, it also meets the food requirements of the people.

4. Importance in International Trade: It is the agricultural sector that feeds country's trade. Agricultural products like tea, sugar, rice, tobacco, spices etc. constitute the main items of exports of India. If the development process of agriculture is smooth, export increases and imports are reduced considerably.

5. Marketable Surplus: The development of agricultural sector leads to marketable surplus. As agricultural development takes place, output increases and marketable surplus expands. This can be sold to other countries.

6. Source of Raw Material: Agriculture has been the source of raw materials to the leading industries like cotton and jute textiles, sugar, tobacco, edible and non-edible oils etc. All these depend directly on agriculture. Apart from this, many others like processing of fruits and vegetables, dal milling, rice husking, gur making also depend on agriculture for their raw material.

7. Importance in Transport: Agriculture is the main support for railways and roadways which transport bulk of agricultural produce from farm to the mandies and factories. Internal trade is mostly in agricultural products. Besides, the finance of the govt, also, to the large extent, depends upon the prosperity of agricultural sector.

8. Contribution to Foreign Exchange Resources: Agricultural sector constitutes an important place in the country's export trade. According to an estimate, agricultural commodities like jute, tobacco, oilseeds, spices, raw cotton, tea and coffee accounted for about 18 per cent of the total value of exports in India.

9. Vast Employment Opportunities: The agricultural sector is significant as it provides greater employment opportunities in the construction of irrigation projects, drainage system and other such activities. With the fast growing population and high incidence of unemployment and disguised unemployment in backward countries, it is only agriculture sector which provides more employment chances to the labour force.

10. Source of Saving: Improvement in agriculture can go a long way in increasing savings. It is seen that rich farmers have started saving especially after green revolution in the country.
This surplus amount can be invested in agriculture sector for further; development of the sector.

11. Source of Government Income: In India, many state governments get sizeable revenue from the agriculture sector. Land revenue, agricultural income tax, irrigation tax and some other types of taxes are being levied on agriculture by the state governments.

12. Basis of Economic Development: The development of agriculture provides necessary capital for the development of other sectors like industry, transport and foreign trade. In fact, a balanced development of agriculture and industry is the need of the day.

Challenges

Three agriculture sector challenges will be important to India’s overall development and the improved welfare of its rural poor:

1. Raising agricultural productivity per unit of land: Raising productivity per unit of land will need to be the main engine of agricultural growth as virtually all cultivable land is farmed. Water resources are also limited and water for irrigation must contend with increasing industrial and urban needs.

2. Reducing rural poverty through a socially inclusive strategy that comprises both agriculture as well as non-farm employment: Rural development must also benefit the poor, landless, women, scheduled castes and tribes. Moreover, there are strong regional disparities: the majority of India’s poor are in rain-fed areas or in the Eastern Indo-Gangetic plains. Reaching such groups has not been easy. While progress has been made—the rural population classified as poor fell from nearly 40% in the early 1990s to below 30% by the mid-2000s (about a 1% fall per year) –there is a clear need for a faster reduction. Hence, poverty alleviation is a central pillar of the rural development efforts of the Government and the World Bank.

3. Ensuring that agricultural growth responds to food security needs: The sharp rise in food-grain production during India’s Green Revolution of the 1970s enabled the country to achieve self-sufficiency in food-grains and stave off the threat of famine. However agricultural growth in the 1990s and 2000s slowed down, averaging about 3.5% per annum, and cereal yields have increased by only 1.4% per annum in the 2000s. The slow-down in agricultural growth has become a major cause for concern.
**Priority areas for support**

1. Enhancing agricultural productivity, competitiveness, and rural growth Promoting new technologies and reforming agricultural research and extension
2. Improving Water Resources and Irrigation/Drainage Management:
3. Facilitating agricultural diversification to higher-value commodities:
4. Developing markets, agricultural credit and public expenditures:
5. Poverty alleviation and community actions
6. Sustaining the environment and future agricultural productivity