**Agriculture – Definition – Importance and scope - Branches of agriculture - Evolution of man and agriculture – Development of scientific agriculture - National and International Agricultural Research Institutes.**

## Agriculture

The term Agriculture is derived from two Latin words **ager** or **agri** meaning **soil** and **cultura** meaning **cultivation**. Agriculture is an applied science which encompasses all aspects of crop production including horticulture, livestock rearing, fisheries, forestry, etc.

**Agriculture is defined as an art, science and business of producing crops and livestock for economic purposes.**

**As an art** it embraces knowledge of the way to perform the operations of the farm in a skillful manner, but does not necessarily include an understanding of the principles underlying the farm practices.

**As a science:** utilizes all technologies developed on scientific principles such as crop breeding, production techniques, crop protection, economics etc. to maximize the yield and profit. For example, new crops and varieties developed by hybridization, Transgenic crop varieties resistant to pests and diseases, hybrids in each crop, high fertilizer responsive varieties, water management, herbicides to control weeds, use of bio-control agents to combat pest and diseases etc.

**As the business:** As long as agriculture is the way of life of the rural population production is ultimately bound to consumption. But agriculture as a business aims at maximum net return through the management of land labour, water and capital, employing the knowledge of various sciences for production of food, feed, fibre and fuel. In recent years, agriculture is commercialized to run as a business through mechanization.

AGRICULTURE is defined in the Agriculture act (1947), as including 'horticulture, fruit growing, seed growing, dairy farming and livestock breeding and keeping, the use of land as grazing land, meadow land, osier land, market gardens and nursery grounds, and the use of land for woodlands where that use ancillary to the farming of land for Agricultural purposes".

## SCOPE AND IMPORTANCE OF AGRICULTURE IN INDIA AND TAMILNADU

- With a 16% contribution to the gross domestic product (GDP), agriculture still provides livelihood support to about two-thirds of country's population.
- The sector provides employment to 58% of country's work force and is the single largest private sector occupation.
- Agriculture accounts for about 15% of the total export earnings and provides raw material to a large number of Industries (textiles, silk, sugar, rice, flour mills, milk products).
- Rural areas are the biggest markets for low-priced and middle-priced consumer goods, including consumer durables and rural domestic savings are an important source of resource mobilization.
- The agriculture sector acts as a wall in maintaining food security and in the process, national security as well.
- The allied sectors like horticulture, animal husbandry, dairy and fisheries, have an important role in improving the overall economic conditions and health and nutrition of the rural masses.
- To maintain the ecological balance, there is need for sustainable and balanced development of agriculture and allied sectors.

- Agriculture's eyes and minds are soothed by dynamic changes from brown (bare soil) to green (growing crop) to golden (mature crop) and bumper harvests.
- Plateauing of agricultural productivity in irrigated areas and in some cases the declining trend warrants attention of scientists.

Agriculture helps to elevate the community consisting of different castes and communities to a better social, cultural, political and economical life. Agriculture maintains a biological equilibrium in nature. Satisfactory agricultural production brings peace, prosperity, harmony, health and wealth to individuals of a nation by driving away distrust, discord and anarchy.

**REVOLUTIONS IN AGRICULTURE**

- Through white revolution, milk production quadrupled from 17 million tonnes at independence to 108.5 million tonnes.
- Through blue revolution, fish production rose from 0.75 million tonnes to nearly 7.6 million tonnes during the last five decades.
- Through yellow revolution oil seed production increased 5 times (from 5 million tonnes to 25 million tonnes) since independence.
- Similarly, the egg production increased from 2 billion at independence to 28 billion, sugarcane production from 57 million tonnes to 282 million tonnes, cotton production from 3 million bales to 32 million bales which shows our sign of progress.
- India is the largest producer of fruits in the world. India is the second largest producer of milk and vegetable.

## BRANCHES OF AGRICULTURE

Seven branches viz.,

1. Agronomy
2. Horticulture
3. Forestry
4. Animal husbandry
5. Fishery science
6. Agricultural Engineering and
7. Home science

**1) Agronomy** – Deals with the production of various crops which includes food crops, fodder crops, fibre crops, sugar, oilseeds, etc. The aim is to have better food production and how to control the diseases.

**2) Horticulture** - Deals with the production of fruits, vegetables, flowers, ornamental plants, spices, condiments and beverages.

**3) Forestry** – Deals with production of large scale cultivation of perennial trees for supplying wood, timber, rubber, etc. and also raw materials for industries.

**4) Animal husbandry** – Deals with agricultural practice of breeding and raising livestock in order to provide food for humans and to provide power (draught) and manure for crops.

**5) Fishery science** – Deals with practice of breeding and rearing fishes including marine and inland fishes, shrimps, prawns etc. in order to provide food, feed and manure.

**6) Agricultural Engineering** – Deals with farm machinery for filed preparation, inter-cultivation, harvesting and post harvest processing including soil and water conservation engineering and bio-energy.

**7) Home Science** – Deals with application and utilization of agricultural produces in a better manner in order to provide nutritional security, including value addition and food preparation.

On integration, all the seven branches, first three is grouped as for crop production group and next two animal management and last two allied agriculture branches.

**Evolution of man and Agriculture**

There are different stages in development of agriculture, which is oriented with human civilization. They are Hunting → Pastoral → Crop culture → Trade (stages of human civilization).

**1. Hunting** – It was the primary source of food in old days. It is the important occupation and it existed for a very long period.

**2. Pastoral** – Human obtained his food through domestication animals, e.g. dogs, horse, cow, buffalo, etc. They lived in the periphery of the forest and they had to feed his domesticated animals. For feeding his animals, he would have migrated from one place to another in search of food. It was not comfortable and they might have enjoyed the benefit of staying in one place near the river bed.

**3. Crop culture** - By living near the river bed, he had enough water for his animals and domesticated crops and started cultivation. Thus he has started to settle in a place.

**4. Trade** – When he started producing more than his requirement the excess was exchanged, this is the basis for trade. When agriculture has flourished, trade developed. This lead to infrastructure development like road, routes, etc.

Agriculture became civilized from crop culture stage. Some important events for different periods that lead to development of scientific agriculture.

| Period | Events |
|---|---|
| Earlier than 10000 BC | Hunting & gathering |
| 7500 BC | Cultivation of crops- Wheat & Barley |
| 3400 BC | Wheel was invented |
| 3000 BC | Bronze used for making tools |
| 2900 BC | Plough was invented, irrigated farming started |
| 2300 BC | Cultivation of chickpea, cotton, mustard |
| 2200 BC | Cultivation of rice |
| 1500 BC | Cultivation of sugarcane |
| 1400 BC | Use of iron |
| 1000 BC | Use of iron plough |
| 1500 AD | Cultivation of orange, brinjal, pomegranate |
| 1600 AD | Introduction of several crops to India i.e. potato, tapioca, tomato, chillies, pineapple, groundnut, tobacco, rubber, American cotton |

**DEVELOPMENT OF SCIENTIFIC AGRICULTURE IN WORLD**

Experimentation technique was started (1561 to 1624) by Francis Bacon. He conducted an experiment and found that water is the principle requirement for plant. If the same crop is cultivated for many times fertility is lost.

Jan Baptiste Van Helmont (1572-1644) was actually responsible for conducting a pot experiment. The experiment is called as 'willow tree experiment'. He took a willow tree of weight 5 pounds. He planted in a pot and the pot contained 200 pounds of soil and continuously monitored for five years by only watering the plant. By the end of $5^{th}$ year, the willow tree was weighing 16 pounds. The weight of soil is 198 pounds. He concluded that water is the sole requirement for plants. The conclusion was erroneous.

In the $18^{th}$ century, Arthur Young (1741-1820) published 'Annals of Agriculture'.

In the beginning of 19th century, scientist Jean Senebier (1742-1809), a Swiss naturalist, a historian, gave explanation that increase in the weight of plant was due to the consumption of air. Theodar Desaussure gave the principle theme of photosynthesis.

Liebig is a German scientist and considered as the 'Father of agricultural chemistry'. It was his opinion that the growth of plant was proportional to the amount of mineral substances available in the soil. This is called as 'Liebig law of minimum'.

**Chronological events in scientific agriculture**

| | |
|---|---|
| Francis Bacon (1561-1624 A.D) | Found the water as nutrient of plants |
| G.R.Glanber (1604-1668 A.D) | Salt peter(KNO3) as nutrient and not water |
| Jethrotull (1674-1741 A.D) | Fine soil particle as plant nutrient |
| Priestly (1730-1799 A.D) | Discovered the oxygen |
| Francis Home (1775 A.D) | Water, air, salts, fire and oil form the plant nutrients |
| Thomas Jefferson (1793 AD) | Developed mould board plough |
| Theodore de-Saussure | Found that plants absorb $CO_2$ from air & release $O_2$; soil supply $N_2$ |
| Justus van Liebig (1804- 1873) | German chemist developed "law of minimum " |

**Advances in Agriculture in 19th Century**

Following Liebig, an agricultural experiment station was started in Rothamsted in England on 1843 (Old Permanent Manurial Experiment – OPME), it dealt with nutrients. Subsequently many developments took place. In U.S. land grant colleges was started in 19th century. Its objective was to meet the expenditure of the college from the land around the colleges. USDA (United States Department of Agriculture) is responsible for the introduction of herbicides 2,4-D and tractor combine for harvesting and threshing. Under Land Grant College, agriculture oriented teaching, research, extension are expanded. Many international research institutes were started for a specific crop.

- 1857–Michigan State University was established to provide agricultural education at college level.
- Gregor Mendal (1866) discovered the laws of hereditary.
- Charles Darwin (1876) published the results of experiments on cross and self fertilization in plants.
- Thomas Malthus (1898) proposed Malthusian Theory – states that humans would run-out of food for everyone inspite of rapid advance in agriculture due to limited land and yield potential of crops (i.e food may not be sufficient in future for the growing population at this current rate of growth in agriculture)
- Blackman (1905) theory of "optima and limiting factors" states that when a process is conditioned as to it's rapidity by a number of separate factors , the rate of the process is limited by the pace of the slowest factor"
- Mitscherlich (1909) proposed the theory of law of diminishing returns that increase in growth with each successive addition of the limiting element is progressively smaller and the response is curvilinear.
- Wilcox (1929) proposed "inverse yield nitrogen law". It states that the growth or the yielding ability of any crop plant is inversely proportional to the mean nitrogen content in the dry matter.

## DEVELOPMENT OF SCIENTIFIC AGRICULTURE IN INDIA

Scientific agriculture got momentum in the 19th century itself. Indian Land Tax was levied in the middle of 19th century. In 1877, 1878, 1889, 1892, 1897 and 1900, the population was decreased due to continuous famines. Only due to these famines, the British regime started many development programmes. Lord Dalhousie (1848-1856) period the 'Upper Bari Doab Canal' in Punjab was constructed. Improvement of agriculture started only in his period. In Lord Curzon's (1898-1905) period, the 'Great Canal system of Western Punjab' was constructed. During his period Imperial Agricultural Research Institute was started in Pusa in Bihar. His period is called as 'Golden period of agriculture'. During his regime, Department of Agriculture and Agricultural colleges for provinces were started at Coimbatore in 1906.

Due to earthquake at IARI in Pusa, Bihar it was shifted to New Delhi. In 1926, Royal Commission on Agriculture was setup and was responsible for giving recommendation to dug canals, lay roads, etc. Based upon the recommendation of Royal Commission, ICAR (Imperial Council of Agricultural Research) was started in 1929 with the objective to conduct agriculture research. State Agricultural Universities (SAU) were started after 1960s). ICAR had also started research institutes of its own in different centres in India for various crops.

ICAR is the sole body, which controls all the Agricultural Research Institutes in India. It paved way for green revolution in India. After 1947, ICAR totally adapted to Land Grant Colleges. In 1962, a Land Grant College was started in Pantnagar (UP). It is the first university with 16,000 acres.

There are 45 state agricultural universities with research institutes on its own. High yielding wheat varieties like Kalyansona, Sonalika, Lerma roja and Sonara-64 were introduced. Green revolution took in wheat first, next in rice after the invention of Indo-*Japanica* variety. Today, agricultural research is multi-dimensional. In includes tissue culture, biotechnology besides breeding, crop production and crop protection.

**Milestones**

1880 - Department of Agriculture was established

1903 - Imperial Agricultural Research Institute (IARI) was started at Pusa, Bihar

1912 - Sugarcane Breeding Institute was established in Coimbatore

1929 - Imperial Council of Agricultural Research at New Delhi (then ICAR) after independence becomes ICAR

1936 - Due to earth quake in Bihar, IARI was shifted to New Delhi and the place was called with original name Pusa

1962- First Agricultural University was started at Pantnagar

1965-67 - Green revolution in India due to introduction of HYV –Wheat, rice, use of fertilizers, construction of Dams and use of pesticides

**In Tamil Nadu**

1876 - Madras Agricultural College was established at Saidapet

1906 - Agricultural College & Research Institute was established at Coimbatore

1971 - Tamil Nadu Agricultural University was started

For institutes visit http://www.icar.org.in/node/325

For state agricultural universities visit http://www.icar.org.in/en/universities.htm

**Institutions - 45**

1. Central Rice Research Institute, Cuttack
2. Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora
3 Indian Institute of Pulses Research, Kanpur
4. Central Tobacco Research Institute, Rajahmundry
5. Indian Institute of Sugarcane Research, Lucknow
6. Sugarcane Breeding Institute, Coimbatore
7. Central Institute of Cotton Research, Nagpur
8. Central Research Institute for Jute and Allied Fibres, Barrackpore
9. Indian Grassland and Fodder Research Institute, Jhansi
10. Indian Institute of Horticultural Research, Bangalore
11. Central Institute of Sub Tropical Horticulture, Lucknow
12. Central Institute of Temperate Horticulture, Srinagar
13. Central Institute of Arid Horticulture, Bikaner
14. Indian Institute of Vegetable Research, Varanasi
15. Central Potato Research Institute, Shimla
16. Central Tuber Crops Research Institute, Trivandrum
17. Central Plantation Crops Research Institute, Kasargod
18. Central Agricultural Research Institute, Port Blair
19. Indian Institute of Spices Research, Calicut
20. Central Soil and Water Conservation Research & Training Institute, Dehradun
21. Indian Institute of Soil Sciences, Bhopal
22. Central Soil Salinity Research Institute, Karnal
23. ICAR Research Complex for Eastern Region including Centre of Makhana, Patna
24. Central Research Institute of Dryland Agriculture, Hyderabad
25. Central Arid Zone Research Institute, Jodhpur
26. ICAR Research Complex Goa
27. ICAR Research Complex for NEH Region, Barapani
28. National Institue of Abiotic Stress Management, Malegaon, Maharashtra
29. Central Institute of Agricultural Engineering, Bhopal
30. Central Institute on Post harvest Engineering and Technology, Ludhiana
31. Indian Institute of Natural Resins and Gums, Ranchi
32. Central Institute of Research on Cotton Technology, Mumbai
33. National Institute of Research on Jute & Allied Fibre Technology, Kolkata
34. Indian Agricultural Statistical Research Institute, New Delhi
35. Central Sheep and Wool Research Institute, Avikanagar, Rajasthan
36. Central Institute for Research on Goats, Makhdoom
37. Central Institute for Research on Buffaloes, Hissar
38. National Institute of Animal Nutrition and Physiology, Bangalore
39. Central Avian Research Institute, Izatnagar
40. Central Marine Fisheries Research Institute, Kochi
41. Central Institute Brackishwater Aquaculture, Chennai
42. Central Inland Fisheries Research Institute, Barrackpore
43. Central Institute of Fisheries Technology, Cochin
44. Central Institute of Freshwater Aquaculture, Bhubneshwar
45. National Academy of Agricultural Research & Management, Hyderabad

**National Research Centres - 17**

1. National Research Centre on Plant Biotechnology, New Delhi
2. National Centre for Integrated Pest Management, New Delhi
3. National Research Centre for Litchi, Muzaffarpur

4. National Research Centre for Citrus, Nagpur
5. National Research Centre for Grapes, Pune
6. National Research Centre for Banana, Trichi
7. National Research Centre Seed Spices, Ajmer
8. National Research Centre for Pomegranate, Solapur
9. National Research Centre on Orchids, Pakyong, Sikkim
10. National Research Centre Agroforestry, Jhansi
11. National Research Centre on Camel, Bikaner
12. National Research Centre on Equines, Hisar
13. National Research Centre on Meat, Hyderabad
14. National Research Centre on Pig, Guwahati
15. National Research Centre on Yak, West Kemang
16. National Research Centre on Mithun, Medziphema, Nagaland
17. National Centre for Agril. Economics & Policy Research, New Delhi

**Important International Institutions on Agricultural Research**

AVRDC- Asian Vegetable Research and Development Centre, Taiwan
CIAT – Centro International de Agricultura Tropical , Cali, Colombia
CIP – Centro International da la Papa ( International potato research institute (Lima, Peru, South America)
CIMMYT – Centro International de Mejoramiento de Maizy Trigo.(International Centre for maize and Wheat development (Londress, Mexico)
IITA –International Institute for Tropical Agriculture, Ibadon in Nigeria, Africa)
ICARDA – International Center for Agricultural Research in the Dry Areas (Aleppo, Syria)
ICRISAT – International Crops Research Institute for the Semi Arid Tropics (Pattancheru in Hyderabad, India)
IIMI- International Irrigation Management Institute, Colombo, SRILANKA
IRRI – International Rice Research Institute (Los Banos, Philippines)
ISNAR- International Service In National Agricultural Research The Hague, Netherlands
WARDA - West African Rice Development Association Ivory coast, Africa.
IBPGR - International Board for Plant Genetic Resources, Rome, Italy
CGIAR – Consultative Group on International Agricultural Research, Washington D.C
FAO – Food and Agricultural Organization, Rome
WMO- World Meteorological Organization, Vienna.