



EVOLUTION AND DEVELOPMENT OF AGRICULTURE

Agriculture originated thousands of years ago. Since then it has served as catalyst for evolutionary change in humans. In the history of human society, there has been a profound shift from a nomadic hunter-gatherer existence to a settled way of life. It was only made possible by the invention and adoption of early agricultural practices. There were many forms of ancient agriculture like ‘Sumerian Agriculture’ of Sumer (at present day Iraq), ‘Aztec and Maya Agriculture’ in Mesoamerica (at present day North America), ‘Roman Agriculture’ (at present day Rome), ‘Chinese Agriculture’ (at present day China), and ‘Indian Agriculture’. In this lesson we will learn about development of agriculture over a period of time and significant achievements of India in agriculture sector.



LEARNING OUTCOMES

After studying this lesson, the learner:

- recognizes how agriculture was gradually developed from ancient times to modern era;
- explains the reasons for backwardness of Indian agriculture during British period;
- identifies the role of ‘Green Revolution’ in alleviating hunger from India; and
- distinguishes the achievement of India after independence in agriculture sector.

1.1 ORIGIN AND EVOLUTION OF AGRICULTURE

The English word agriculture is originated from the Latin word ‘ager’ (meaning –field) and ‘cultura’ (meaning – to cultivate). When combined, the word ‘agriculture’ means cultivation of field. Agriculture can be defined as the art and science of cultivating the

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soil, producing crops, raising livestock as well as preparation and marketing of the resulting products. Therefore, agriculture can be summarised in many ways. Crop plants and domestic animals sustain the human population by providing food and other products.

Primitive man collected wild fruits, grains, other natural products and consumed them as food. Around 12000 years ago, agriculture was first emerged which led to a significant change in human behavior. Due to this, life style of people changed from a nomadic life to a settled life of farming and permanent communities. Different regions of the world saw the independent emergence of agriculture. There were at least 11 different regions in the world evolved as independent centres of origin for various crops.

- On the beaches of the Sea of Galilee, the Ohalo II people were the oldest known inhabitants to have practised small-scale cultivation of edible grasses during dates back 21,000 BC.
- The Levant (a large area in the Eastern Mediterranean region of Western Asia) was home to the eight Neolithic founder crops by about 9500 BC. It included emmer wheat, einkorn wheat, hulled barley, peas, lentils, bitter vetch, chickpeas, and flax. Wheat was the first to be grown and harvested on a significant scale.
- On the banks of the Nile, farming had become established by 8000 BC.
- Around this period, independent agricultural development took place in the Far East, most likely in China, with rice replacing wheat as the main crop. The earliest evidence of cultivation of rice is found in China at 5700 BC. The millet became the main crop of the Yellow River basin in China by 5500 BC that was domesticated by early Sino-Tibetan speakers at around 8000 to 6000 BC. Thereafter, mung, soy, and azuki beans were also domesticated in China by 6200 BC. Rice cultivation had later extended to South-East Asia around 3,500 to 2,000 BC.
- By 6700 BC, the wild grass Teosinte in southern Mexico had been domesticated into maize. In the New World, domesticated plants included the potato (8000 BC), tomato, pepper (4000 BC), squash (8000 BC), and several varieties of bean (8000 BC onwards).
- Sheep and pigs were the first domesticated animals in Mesopotamia roughly 11,000 years ago. In the regions of present day Turkey and India, cattle were domesticated during 8500 BC. It took a long time to domesticate camels, possibly around 3000 BC.

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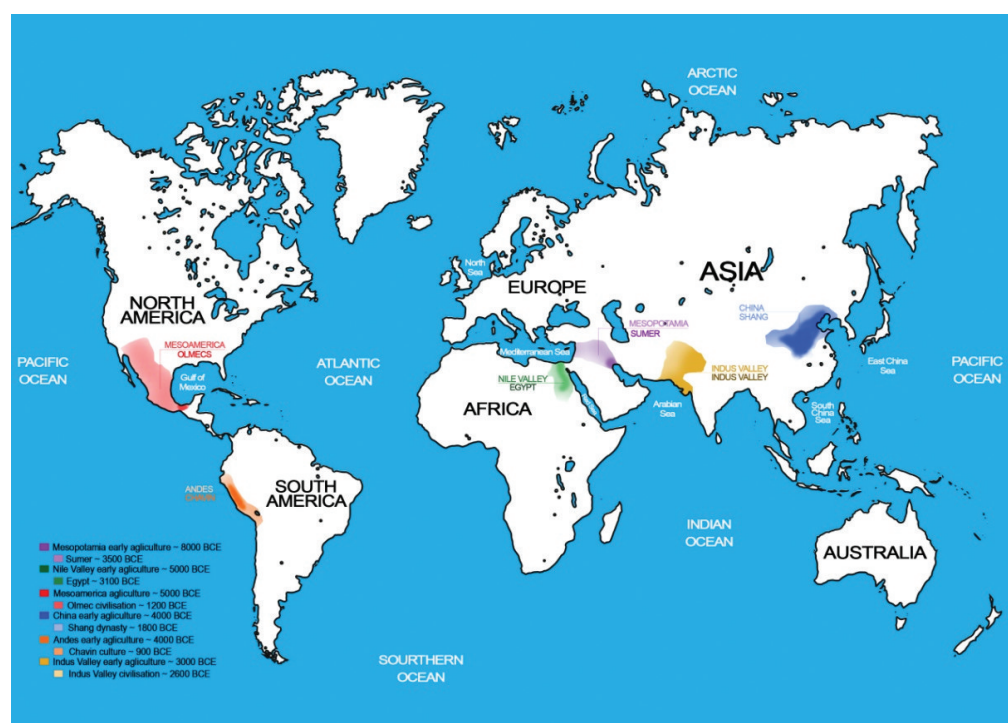


Fig. 1.1: Earliest civilizations of the world

Following the Neolithic Revolution, the ‘British Agricultural Revolution’ marked the beginning of a 200-year period of rapid advancement with the development of irrigation, crop rotation, and fertilizers.

Since 1900, agricultural productivity has increased significantly in developed countries, and to a lesser extent, in developing countries due to mechanization, aided by synthetic fertilizers, pesticides, and selective breeding.

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**INTEXT QUESTIONS 1.1**

- The word agriculture is derived from which language?
- How many centres of origin are believed to be existed?
 - 5
 - 7
 - 9
 - 11
- Agriculture first emerged around 12000 years ago (True/False).
- was the wild relative of maize and was domesticated in area of
- Earliest evidence of cultivation of rice was found in
 - Mesopotamia \
 - Egypt
 - China
 - Rome

**ACTIVITY 1.1**

You have read that before emergence of agriculture, human was hunter and gatherer. You must have seen few glimpses of these ancient men in your history book. Can you visualize their daily life? Imagine how they satisfied their hunger. Discuss and share your thoughts with parents and friends.

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1.2 NEOLITHIC REVOLUTION

After emergence of agriculture around 12000 years ago, it caused rapid shift in people's lifestyle and human society. This advancement is known as the 'Neolithic Revolution'. V. Gordon Childe coined the term 'Neolithic Revolution' in 1936. The Neolithic Revolution began in the Fertile Crescent in Near East (a region covering modern day eastern Turkey, Iraq, and south-western Iran). Agricultural growth improved living of people. It changed from a hunter-gatherer way of life to farming and permanent settlements. These permanent settlements gave emergence of cities and civilizations.

This shift in human lifestyle also impacted the agricultural environment. Because of this advancement, it was now possible to raise crops and animals to meet demand of food. Thus the world's population increased.

Human societies underwent a number of changes as a result of the Neolithic revolution which are depicted in figure 1.2

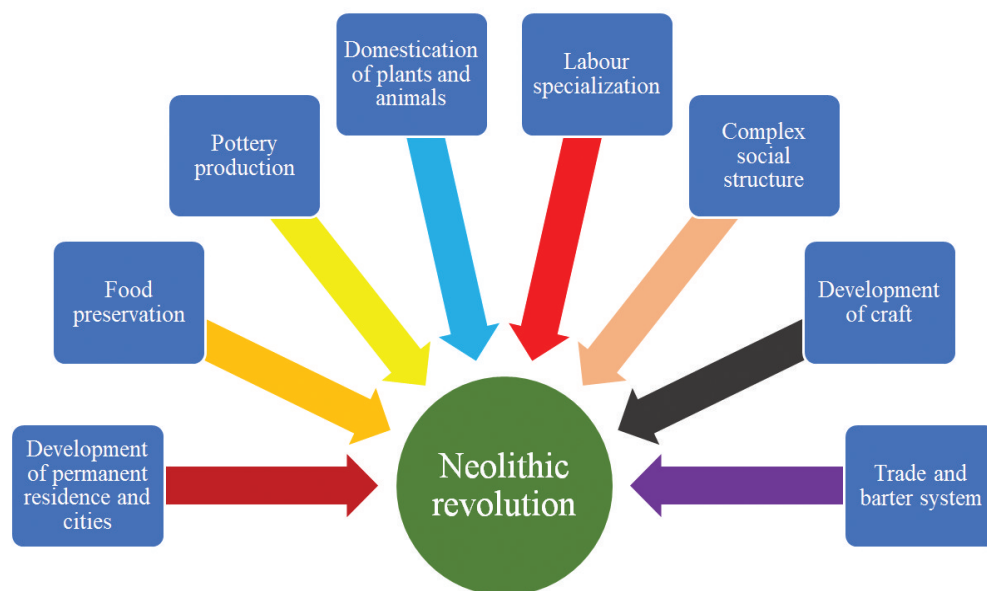


Fig. 1.2: Characteristics of Neolithic revolution

In different places of the world, people began farming for a variety of reasons.. It is believed that there was a major climatic shift at the end of the last ice age in the Near East. Such change in seasonal conditions benefitted annual plants like wild grains. Increased pressure on the natural food resources in other places, such as East Asia, might have compelled individuals to come up with their own remedies. But, there is no doubt that farming initiated the development of primitive men regardless of its independent beginnings.

Domestication of Plants and Animals

The definition of domestication is simply “to put plants or animals under human control or tame”. Domestication has made life easier for humans by providing food, labour, other products, and companionship.

A. Plant Domestication

Wheat, barley, and peas are the crops whose wild ancestors were found throughout the Near East region. Rice and millet farming both have their roots in China's Neolithic era. The earliest known rice fields in the world were found in



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eastern China, and they give proof of early farming methods including flood and fire control.

Through this process, many behavioral features between wild species and current domesticated populations have evolved. For example, the grains of wild plant species like wheat, barley, and rice frequently fall on the ground before they are fully matured, thus making their harvesting difficult. However, when cultivation and irrigation practices were developed, many of these plants' natural characteristics were lost. With careful attention from the early farmers, yields finally improved. The Neolithic farmers chose cultivars that could preserve seeds for mature harvesting for a longer period of time.

B. Animal Domestication

The beginning of the domestication of formerly hunted animals is another significant part of the Neolithic revolution. Cattle, goats, sheep and pigs were originated as domesticated animals in the Fertile Crescent of Near East region. Factors, such as the animal's size, temperament, food, mating habits, and lifespan governed the domestication process. Ability to plough and utility as a food source were the most important considerations for selection of animals.

In early Neolithic civilizations, these animals provided a significant portion of the food and protein. Milk, a significant source of protein, was produced by animals like cows and goats. Some animals also produced materials such as leather, wool, skins, and fertilizer.

Technological Achievements during Neolithic Revolution

New technologies were created as a result of the need for improved tools and weapons to support the new way of life. Neolithic people first made tools for agricultural use, and later they created metal-working techniques to meet their needs. One of the key features of Neolithic civilisation is the invention of pottery. The wheel is considered a remarkable achievement of the Neolithic Period. The wheel's invention allowed people to carry heavy loads and made transportation faster and easier. It saved the primitive human's time that they could use for other activities.

The Neolithic period marked the beginning of man's production of ground and polished stone tools, also known as Celts. These axes and adzes were presumably used to cut trees and break up the land so that it could be utilized for farming. Celts with pointed ends may have served as hoes or ploughs. Most likely, several of these tools were also employed for tilling the soil in addition to clearing the land.



Various locations throughout the world experienced the Neolithic Revolution in unique and separate ways. In the Near East, pottery emerged after agriculture, whereas in Japan, pottery advanced significantly before agriculture. Ploughs, tools, methods of seed selection, and irrigation systems were only a few of the technical advancements that were directly related to agriculture and developed at a faster rate as the towns grew.

Model of David Harris on The Origin of Agriculture

David Harris provides a four-stage transition paradigm from hunting-gathering to agriculture.

1. **In the first stage**, hunters and gatherers gather and protect beneficial plants and fruits, periodically burn the unwanted vegetation to reduce competition between plants, and lessen soil disturbance. At this point, the environment is not being significantly transformed or being significantly influenced on a broad scale by human activity. This type of wild plant-food economy is a development from even earlier hunting lifestyles.
2. **The second stage**, which may be seen as a crucial step toward agriculture, is characterised by the cultivation of wild plant-food with some ploughing. Planting, seeding, and weeding of wild plants were used to maintain plant populations in their natural state. Men planted seeds from a few carefully chosen plants with favourable traits in new environments, and some of the harvested seeds were saved for later use.
3. **The third stage**, in which the ground was cleared and food-producing operations like planting, weeding, plant propagation, etc. were carried out extensively. Systematic tillage of land is a major characteristic of this stage. The plants underwent significant morphological and genetic alterations as a result of meticulous care. Care increased the number of seeds, which caused an increase in output. In terms of food, this might allow a sizable number of human groups to reside continuously in one location.
4. **'The fourth stage'** The development of new, highly energy-intensive technologies for food production is considered the ultimate step. Initially, men selectively cultivated plants, choosing those that produced more. This energy-intensive stage ultimately led to the emergence of new genotypes that meet human requirements more effectively.

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**INTEXT QUESTIONS 12**

1. The transition from a nomadic hunter-gatherer way of life to farming and permanent settlements is known as
2. Who coined the phrase 'Neolithic Revolution'?
3. What is Domestication?
4. What was known as man's production of ground and polished stone tools?
5. Periodical burning of vegetations to lessen plant competition was seen in stage of agricultural development.

**ACTIVITY 1.2**

You have studied about ancient civilizations in preceding section. Have you noticed that all these civilizations flourished near the banks of river? Can you think any reason for this? Write down your thoughts.

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1.3 HISTORY OF AGRICULTURE IN INDIA

As we have seen in the Neolithic Revolution, Indian agriculture also transformed from a nomadic way of hunting and gathering to farming in permanent settlements. Let's discuss this development through different eras.

Pre-Vedic Era

In the Indian subcontinent, agriculture started as early as 9000 BC, and around that time, crops like wheat, barley, and jujube were domesticated.

A. North India

The knowledge of crop production as a component of the agricultural system grew more clearly during the "Indus Valley" civilization, also known as the "Harappan civilization". It existed between 2300 and 1600 BC in the western

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Punjab and Sind regions of the Indian subcontinent. Eastern Punjab, western Uttar Pradesh, Rajasthan, western Madhya Pradesh, and Gujarat were eventually colonized by the “Harappan” culture.

- ❖ Their agricultural system included the cultivation of wheat and barley. As both the crops had originated in central Asia, it was determined that the “Indus Valley” and the “Mesopotamian” civilizations had interaction.
- ❖ Chickpea, a pulse, was found at the Harappan site, and sesame, an oilseed, possibly imported from Mesopotamia or Africa, was also grown there during the Harappan civilization.
- ❖ Mustardseeds (*Brassica juncea*) were also found at the Chanhu-daro site, indicating its growth in Sindh.
- ❖ A small piece of Mohenjo-daro cotton fabric revealed that the Indus Valley civilization was the first to spin and weave cotton fibers. The principal goods exported by the Harappans to Mesopotamia were cotton fabrics, which they traded for money and woolen clothing.
- ❖ Evidence of fruit availability during the Harappan civilization indicates the cultivation of dates, lotuses, coconuts, pomegranates, lemons, and melons.

B. South India

- ❖ The evidence of cultivation from Hallur, Karnataka indicates that **ragi** (1800 BC) was a preferred crop in the southern peninsular region. **Horsegram** grains (1780–1500 BC) were found at Tekkalakota, Karnataka, and are considered a pulse.
- ❖ The grains found in Maharashtra also suggest growing a number of **small millets**. **Lentil**, **greengram**, and **blackgram** were all cultivated as agricultural crops around 1500 BC at Navdatoli in Tamil Nadu. In addition, **sorghum** was grown among the millets; **linseed** and **castor** were grown among the oilseeds; **ber** and **amla** were grown among the fruits.

Vedic Era

Add this sentence - During this period, Eastern Afghanistan, the North West Frontier Province, Kashmir, Punjab, and portions of Sind and Rajasthan were all under the control of the Aryans. These area got its name “Saptasindhavah” from the seven rivers Sutlej, Beas, Ravi, Chenab, Jhelum, Indus, and Saraswati that flow through this fertile land.

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- The Rig-Veda, the oldest literature of the Aryans, mentions barley, white- and black sesame, sugarcane, cucumber, and bottle gourd during the early Vedic era (1500–1000 BC). Although Harappans grew wheat and cotton, the early Aryans might have stuck to barley as their staple diet in their own area.
- Early Vedic literature does not contain any references to rice. It was only after they established their dominion into Uttar Pradesh and Bihar that they learned about rice.
- Sama-Veda, Yajur-Veda, and Atharva-Veda were among the Vedic literatures that were written between 1000 and 600 BC, during the later Vedic periods. The Mahabharata and the Ramayana were also written at same time. These writings make reference of farmed and wild rice, barley, wheat, maize, *bajra*, foxtail millet, proso-millet, barnyard millet, kidney beans, lentils, sesame, and coix.
- Two crops were typically grown each year. Barley was sown in the winter and reaching maturity in the summer, while rice was planted in the rainy season and harvested in the autumn. When the summer rains started, beans and sesame were planted, and they were harvested in the winter's colder months. It's also possible that cucumber was grown during that period.

Agriculture during Ancient Dynasties

- **The Magadha Empire (544-492 BC):** They ruled over territories in eastern India. Rice was their preferred cereal crop and pulpy rice was served as the main course.
- **The Mauryan dynasty (322-232 BC):** During the reign of *Ashoka* (274–237 BC), the plantations of banana, mango, jackfruit, grape, and date palm were developed.
- **Sungas, Satvahanas, and Kushan Empires (200 BC-200 AD):** Coconuts are often cultivated in coastal regions as it can be used for copra, oil, oilcake, fibre and several other purposes.
- **Pandys, Cheras, and Cholas (1st century Christian era-300 AD):** Bamboo, rice, jackfruit, *ragi*, sugarcane, pepper, turmeric, and cotton were cultivated at various regions of southern India dominated by these dynasties.
- **Gupta era (300–550 AD):** Cultivation of red rice, yellow rice, and hog's rice were mentioned. *Sali* rice's ability to grow suggested that they were familiar with the process of transplanting rice. Other crops were also grown, including

vegetables (cucumber, onion, pumpkin, and gourd), cereals (rice, wheat, and barley), pulses (peas and lentil), oilseeds (sesame, linseed, and mustard), spices (pepper, cardamom, cloves, ginger, and turmeric), and fibre crops (cotton, flax, and hemp).



DO YOU KNOW

Sali is a type of rice specially grown in winter months. It is a tall and late maturing variety which contains many medicinal properties for curing piles, skin burn, haemorrhoids bleeding, anemia.

- **Empire of Harshavardhana (606–647 AD):** A Chinese traveller Hiuen Tsang travelled to Kanauj, the capital of Harshavardhana. In his travelogue Si-yu-ki, a 60-day mature rice cultivar was specifically mentioned. He added that there was another rice cultivar with a remarkable smell. Hiuen Tsang's student Shaman Hwui Li described a unique type of rice with huge seeds that smelled strongly of black beans.
- ***Chalukyas, Rashtrakutas, Pallavas, Pandyas, Hoysalas, and Kakatiyas (535-1300 AD):*** They controlled southern India. Millets were only grown in the Deccan and Mysore plateau's rainfed regions at that time, whereas rice farming was expanded to a number of sites with available irrigation infrastructure. In addition, the entire territory was used to cultivate sugarcane, sesame, ginger, pumpkin, yam, mango, coconut, and jackfruit.
- **Reign of Rajputs, Palas and Senas:** Between 650 and 1155 AD, several *Rajput* emperors governed north India, while Bengal was ruled by *Palas* and *Senas* between 760 and 1205 AD. Eight varieties of rice with various colours, scents, sizes, and growing seasons have been mentioned in Sanskrit writings. While rice was a staple food of the royal diet in Kalinga and well-known in *Magadha*. There were many of coconut, ginger, and cinnamon trees. Different kingdoms also cultivated cotton and indigo.
- **The literature of *Medhaitithi, Parashara, Kashyapa, and early Arabs (900-1100 AD):*** According to their texts, rice, mangos, coconuts, and lemons were cultivated in significant amounts and sugarcane, pepper, and bamboo grew in special regions. *Kashyapa* gave clear explanations of the cultivation of rice and its transplanting, weeding, irrigation, crop protection techniques, harvest, threshing, seed selection, and storage.



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- **The Delhi Sultanate (1206–1526 AD):** The Islamic Empire controlled a sizable portion of the Indian subcontinent. *Ibn Battuta* provided a thorough description of the crops that were farmed at this time. The crops were planted twice a year, once in the spring and once in the summer when rain occurred.
- **The Vijayanagara Empire (1336–1646 AD):** Field crops grown at this time included rice, wheat, *jowar*, barley, beans, greengram, and horsegram, while fruit crops included sweet and sour oranges, wild brinjal, pomegranate, and grapes.
- **The Portuguese:** Through marine routes that passed through Portugal, Brazil, Cape of Good Hope, and Goa in India, the Portuguese brought new American and African crop plants to the country. The newly introduced crops were tomato, maize, papaya, guava, groundnut and tobacco. In the sixteenth century, the Portuguese brought chillies from Brazil or Peru to India, and in the seventeenth century, they brought potatoes from Chile or Peru. They also made a huge contribution by developing the ‘grafting’ process in 1550.

Mughal Era

- A. **Babur:** Babur’s invasion in 1526 marked the beginning of the *Mughals*’ power in India. Various crops like mango, banana, tamarind, *mahua*, *jamun*, *chironji*, jackfruit, *ber*, *amla*, lime, orange, date palm, coconut, and toddy palm were described by Babur in his autobiography, the *Babur-nama*. He also described the availability of certain exquisite flowers like white jasmine, oleander, and gurhal. It is said that Babur brought the fragrant Persian rose to India.
- B. **Akbar:** The *Mughal* Empire was controlled by *Akbar* from 1555 to 1605. *Abu’l Fazl*, the court historian of *Akbar*, and several other European travellers provided extensive descriptions of the crops, flowers, and fruits that were grown there during *Akbar*’s administration. These texts noted that while barley and chickpeas were planted throughout, wheat was mostly grown in India’s north-western region. Chickpea, lentil, pea, greengram, blackgram, and arhar (pigeonpea) were the most common pulses. The oilseed crops farmed during that period included sesame, linseed, toria, mustard, and safflower. In addition, tobacco, sugarcane, cotton, hemp, indigo, poppies, betel nuts, melons, gourds, and pumpkins were all grown. In Kashmir, saffron was grown. According to *Abu’l Fazl*, Bengal had the biggest sugarcane production.
- C. **Shah Jahan:** A better kind of cherry, peach, plum, and grape was imported from Persia and Afghanistan under the reign of *Shah Jahan* (1628–1658).

**British Era**

The East India Company had come to India for trading. But after the Battle of Plassey in 1757, they began to govern over substantial portions of the country. At that time ginger, saffron, cardamom, pepper, cocoa, and other palm-yielding nuts were the main spices consumed by the native Indians. Mango was considered the best fruit all over India. Pomegranate, citron, date, almond, grape, pineapple, and tamarind were the other native fruits. European fruits, such as apples, pears, plums, and apricots were produced in the northern regions.

- The local artisans of India used to transform the short staple and coarse cottons into very fine yarns. In order to meet the demands of the Lancashire textile industry of Great Britain, the Governor General of Calcutta promoted the growth and improvement of Indian cotton.
- In the 18th and 19th centuries, the British attempted to modernise Indian agriculture by introducing new crops, institutions, and processes. But main aim behind this modernization was to improve businesses of East India Company. Rice, cotton, indigo, opium, and other agricultural products from British India became important commodities in the world trade.
- The amount of cultivated land significantly increased in the second half of the nineteenth century. A consistent increase in yield per acre was also observed as new crops became exportable. Agriculture significantly expanded in the region of Punjab, the Narmada valley, the western portion of the United Provinces, and coastal Andhra Pradesh.
- During the period of war, food availability decreased significantly. Frequent famines were observed all over India. Bengal saw the worst effects of the crisis.
- Wide scale improvements to Indian agriculture began during the second part of the 19th century. A department of agriculture was established in India in 1871. But the department rarely did anything for improvement of agriculture beyond data collection and famine relief report. Therefore, government decided to create a central “Department of Agriculture” as well as agriculture departments in the provinces. This department was empowered to handle agricultural research, agricultural development, and famine relief in the nation.
- Following the catastrophic famines of 1899–1900, Lord Curzon, the Viceroy of India at the time, determined to establish colleges for agricultural training. As a result, the Agriculture Research Institute for advanced agricultural training was established in Pusa, Bihar in 1905.

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- An All India Board of Agriculture was founded in 1905 to provide useful advice for improvement of agriculture to the government. The Indian Agriculture Service was also established in 1906.

**INTEXT QUESTIONS 1.3**

1. Agriculture started in India around
2. Which crop was used as staple diet by early Aryans?
3. Name any two crops introduced by Portuguese in India.
4. For the promotion of trade and commerce, the British East India Company encouraged the cultivation of
 - a. Cotton
 - b. Indigo
 - c. Opium
 - d. All of these

**ACTIVITY 1.3**

You must have taken the tomato sauce/chutney or chillies in your daily meal. Have you wondered by knowing that such crops like potato, tomato, chillies are not Indian origin? The Portuguese bought these in India. Before introduction of chilli, traditionally Indians used another crop for making similar flavour. Can you name this crop?

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1.4 BRITISH AGRICULTURAL REVOLUTION

The British agricultural revolution was a remarkable increase in agricultural production in the Britain. This revolution is also known as the second agricultural revolution. This was caused due to efficient use of land and labour in mid 17th and late 18th centuries. Such rise in agricultural productivity declined the need of additional labour on agricultural land. These additional labours then contributed to the development in industries in urban areas. Therefore, the British agricultural revolution is considered as cause of industrial revolution in Europe.

The British Agricultural Revolution was the result of the complex interaction of social, economic and farming technological changes. The major agricultural developments and innovations in this period include:

- Norfolk four-course crop rotation
- Modification of the Chinese plough to allow it to be pushed by fewer oxen or horses
- The abolition of common rights on land and establishment of exclusive ownership of land.
- Growth of a national market free from tariffs, tolls and customs barriers
- Improvement of transportation infrastructures, such as enhanced roads, canals, and later, railways
- Land conversion and reclamation
- Construction of field drainage structures
- Increase in farm size
- Selective breeding

The second revolution could be divided into three stages:

1. The **first stage** of this revolution is transition from subsistence farming to cash farming for the market. At this stage, mostly the previous practises of cultivation and the physical layout of farms were preserved.
2. The **second stage** involved the technical changes of crop rotations and livestock improvement. It also typically involved abolition of common rights on land or enclosure. Farmers were more market-oriented in choosing which crops to raise, when to raise and in what quantities.
3. In the **third stage**, tractors replaced horses and a variety of machines like mowers, reapers, binders, tedders, and threshers replaced human labour. In addition, farmers began using fertilizers which made possible to grow cereal crops continuously.

As a result of these advancements, farm resources were being used in more efficient, rational and orderly manner. Farmers are benefitted from better yield and higher income per unit of land.



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Norfolk Four-course Crop Rotation

Crop rotation is the successive cultivation of different crops in a definite order on the same fields. Norfolk four-course crop rotation system is sequential growing of four crops in four year cycle on a same piece of land. This was created in Norfolk County, England and popularized by British agriculturist Charles Townshend.

Wheat was planted in the first year of the Norfolk four-course system, turnips in the second, barley in the third and clover as well as ryegrass were sown in fourth year. The ryegrass and clover were grazed or harvested for fodder. Turnips were fed to sheep and cattle throughout the winter. The soil was nourished from the sheep's excreta during grazing in fields. Subsequently, it encouraged greater crop harvests in following years. The benefits of this new system were increased availability of fodder crops for livestock's consumption and abundance of animal manure.

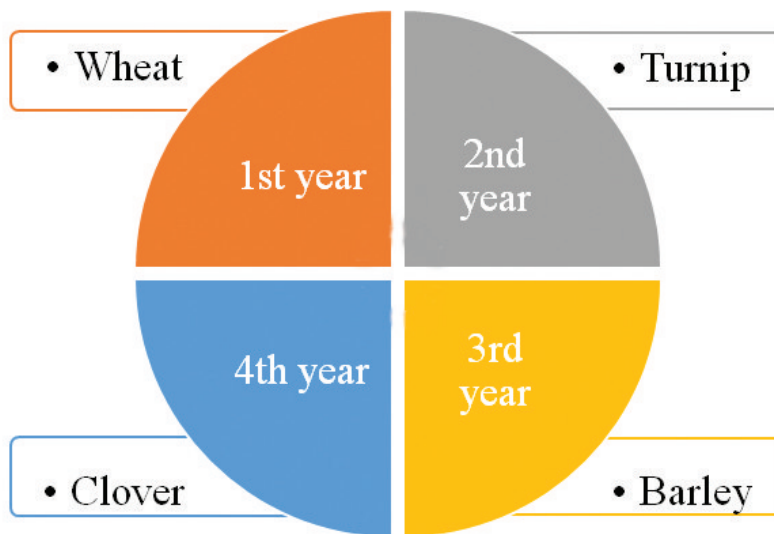


Fig. 1.3: Norfolk four course crop rotation

**INTEXT QUESTIONS 1.4**

1. Unprecedented rise in agricultural production in the Britain is termed as
2. Enlist the major change in approach toward farming during second agricultural revolution.
3. Replacement of manpower and animals by machines took place in which stage of British Agricultural Revolution?

4. Which fodder crop was cultivated in the Norfolk four-course crop rotation system?
- | | |
|-----------------|------------|
| a. Maize | b. Clover |
| c. Napier grass | d. Lucerne |

1.4 GREEN REVOLUTION

The 'Green Revolution' or third agricultural revolution was a period of great increase in food production (especially rice and wheat) due to introduction of high yielding varieties of crops. These new varieties required large amounts of fertilizer and pesticides for higher production. The first achievements of 'Green Revolution' were observed in Mexico and the Indian subcontinent. Green Revolution was initiated by Norman E. Borlaug in the 1960s. He is renowned as the 'Father of the Green Revolution' while M.S. Swaminathan was the leading architect of India's Green Revolution.

The Bengal Famine occurred in India during 1943. It affected approximately 4 million people in eastern India. As population growth was exceeding food production, the government emphasized the development of agriculture in India. This required urgent and aggressive efforts to boost production and the 'Green Revolution' served as the catalyst for this action.



Fig. 1.4: Severity of the Bengal Famine (1943)

During 'Green Revolution' which occurred between 1967-68 and 1977-78, Indian agriculture transformed into an industrial system. It adopted modern methods and technology, such as the usage of High Yielding Varieties (HYV) seeds, tractors, irrigation systems, pesticides, and fertilizers. This initiative was sponsored by the U.S. and Indian governments, as well as the Ford and Rockefeller Foundations.



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This revolution transformed India from a food-deficient country to one of the world's leading agricultural nations. In India, the 'Green Revolution' significantly increased agricultural productivity, especially in irrigated areas and in states like Haryana, Punjab, and Uttar Pradesh. The development of high-yielding wheat seeds and rust-resistant wheat strains were significant achievements in this effort. Between 1967-68 and 2003-04, wheat production increased more than three-fold, while cereal production increased by two times.

Basic Elements of the Green Revolution

- I. Expansion of farming areas:** Although the cultivated land has been increasing since 1947, it was insufficient to meet rising demand. The 'Green Revolution' helped in the expansion of land under cultivation.
- II. Double-cropping System:** As there is only one rainy season in a year, the practice of one crop per year was prevalent. Double cropping was a chief feature of the 'Green Revolution' where two crops were being cultivated per year.
- III. Using seeds with improved genetics:** Use of superior quality seeds was the another characteristic of the 'Green Revolution'. The Indian Council for Agricultural Research (ICAR) introduced new strains of high yield variety seeds, primarily wheat, rice, millet, and maize.

Overall, the green revolution played a significant role in providing food security for developing nations like India.

Drawbacks of Green Revolution

Apart from food security, little attention was paid to the environment and economic condition of farmers during green revolution. As a result, several negative effects are being felt at present times. These are as follows:

- Pollution of soil, water and air due to excessive use of fertilizers and pesticides
- Reduction in biodiversity of cropland due to preference of few high yielding crops by farmers
- Depletion in ground water resources as new crops have higher water demand
- Deterioration of soil quality and fertility
- High cost of inputs, such as seeds, fertilizers, and pesticides has led many farmers to fall into debt. Small and marginal farmer cannot afford these inputs while big farmers can easily make profit. As a result, disparity between farmers increased.



The Evergreen Revolution

The benefit of 'Green Revolution' came at the expense of adverse environmental effects. Start the paragraph with this highlighted sentence and keep the present first sentence as second sentence. As a result, Dr. M.S. Swaminathan, India's Father of Green Revolution, emphasised the necessity for 'Evergreen Revolution'. The 'Evergreen Revolution' envisions increased production with protection of environment. The agricultural practices should be ecologically safe, economically viable, and socially sustainable. The evergreen revolution recommends the incorporation of ecological concepts into the creation and spread of technology.

Other Revolutions in Agriculture

Apart from 'Green Revolution', India also witnessed increased production/revolution in several other allied sectors of agriculture. These are in as indicated below:

White Revolution:	Milk Production
Yellow Revolution	Edible oil (oilseeds) production
Blue Revolution:	Fish Production
Brown Revolution:	Food Processing
Grey Revolution:	Fertilizer Production
Red Revolution:	Tomato/Meat production
Pink Revolution:	Prawn/Onion production
Golden Revolution:	Fruit Production
Silver Revolution:	Egg/Poultry production



Norman Ernest Borlaug

(25th March, 1914 - 12th September, 2009)

Dr. Norman Ernest Borlaug was an American plant pathologist, widely known as 'Father of Green Revolution'. Born in Cresco, Iowa, USA at Norwegian immigrant family. From childhood, he actively participated in football, baseball and wrestling teams at Cresco High School. He obtained his B.S. degree in forestry in 1937, M.S. (1940) and Ph.D. in Plant Pathology & Genetics (1942) from University of Minnesota. After that he joined CIMMYT, Mexico as an agricultural scientist where he developed semi-dwarf, high yielding, disease-resistant wheat

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varieties. These wheat varieties along with modern agricultural practices led to jump in food production in Mexico and other countries, therefore help in achieving food security for billions of people. He was awarded Nobel Peace Prize in 1970 for his contribution. In 2006, Government of India conferred him 2nd highest civilian award 'Padma Vibhushan'. He created an international award called 'World Food Prize' for recognizing exceptional contribution in the field of agriculture. To continue the legacy of Norman Borlaug, Government of India and CIMMYT through their collaborative effort established Borlaug Institute of South East Asia (BISA) in 2011.

**M.S. Swaminathan**

(7th August, 1925 - 28th September, 2023)

Mankombu Sambasivan Swaminathan, an Indian agricultural scientist and plant geneticist who was the main architect of transforming Indian agriculture during mid 1960s. He was born in Kumbakonam of Madras presidency (present day Thanjavur, Tamil Nadu). Witnessing the tragedy of Bengal famine during 1943, he decided to work for ensuring food security of India. After graduating from Maharaja's College (in Zoology) and Madras Agricultural College (in Agriculture), he went on studying genetics and plant breeding at Indian Agricultural Research Institute (IARI), New Delhi. His contribution in developing high yielding varieties of rice and wheat saved millions of people from famine like situation in South East Asia especially in India and Pakistan. For this leadership role in Indian agricultural movement, he is widely regarded as 'Father of Green Revolution in India'. The United Nations Environment Programme has called him 'The Father of Economic Ecology'. He was the first recipient of World Food Prize in 1987. He had also served as Director General of Indian Council of Agricultural Research (ICAR) and International Rice Research Institute (IRRI). A non-profit NGO trust 'M.S. Swaminathan Research Foundation' (MSSRF) was established by him to promote increased employment of poor women in rural areas.

**Verghese Kurien**

(26 November 1921 - 9 September 2012)

Verghese Kurien was a pioneer dairy engineer who is widely regarded as 'Milkman of India'. Born in Cochin, Kerala, he was graduated in physics and mechanical engineering. After completing his education, he started working for Government of India as an officer in Dairy Division at Anand, Gujarat.

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Looking at the exploitation of local milk producers, he established the Kaira District Cooperative Milk Producers' Union Limited in 1950. Later, it became famous Amul dairy. Amul established a cooperative among the rural dairy producers and facilitated direct communication between them and customers. The dairy cooperative was effective in raising the amount of milk produced. Due to his untiring effort, India has become self sufficient in milk production. He was also the founding chairman of National Dairy Development Board. For his extraordinary achievement, He was awarded with Ramon Magsaysay Award (1964), World Food Prize (1989), Padma Vibhushan (1999).

**INTEXT QUESTIONS 1.5**

1. Who is considered as the father of Green Revolution?
2. The Green Revolution in India was led by
3. Which organisations sponsored Green Revolution in India?
4. Which of the following state experienced the impact of Green Revolution the most?
 - a. Bihar
 - b. Punjab
 - c. Assam
 - d. Maharashtra
5. White revolution is related to
 - a. Tomato
 - b. Fruit
 - c. Milk
 - d. Fish

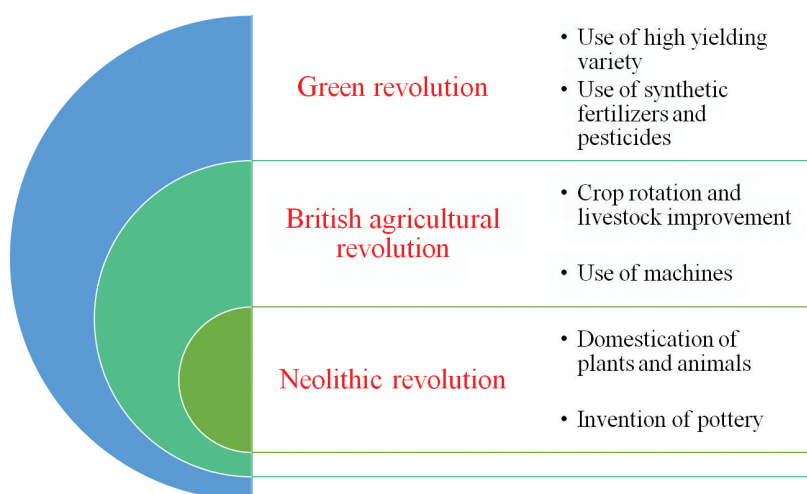


Fig. 1.6: Evolution of agriculture

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Significant Achievements of Indian Agriculture in Post Independence Era

Transition from food deficient to food surplus country due to green revolution

Became the top producer of cotton, pearl millet and pulses

Became second largest producer of rice, wheat, sugarcane, groundnut, rapeseed and mustard

Introduction of Bt cotton variety

First nation to develop composite variety of maize

Development of hybrid variety of pearl millet, pigeon pea, castor and cotton

Development of biofortified and climate resilient variety of various crop

First nation to defeat stem rust disease of plant caused by Ug99 race

Decoding genomic sequence of jute, chick pea, rice and pigeon pea

1.6 HISTORY OF AGRICULTURAL EDUCATION & RESEARCH IN INDIA

Although early agricultural practices were mentioned in Vedas and Upanishads, there was no formal system of agricultural education in India till 1877. First agricultural college in India was established at Saidapet, Tamil Nadu in 1877 which was later shifted to Coimbatore. In 1898, Bengal Engineering College, Shibpur started formal agricultural education programme. Need to establish a large scale education system was felt during beginning of 20th century. As a result, Imperial Agricultural Research Institute (IARI) was established at Pusa, Bihar in 1905 with the donation of American philanthropist Mr. Henry Phipps, followed by establishment of colleges at other places like Kanpur, Nagpur, Lyallpur and Coimbatore in 1906, Pune in 1907 and Sabour in 1908.



Fig. 1.7: Imperial Agricultural Research Institute at Pusa, Bihar

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The agricultural education programme of Bengal Engineering College, Shibpur was shifted to IARI with its establishment at Pusa, Bihar in 1905. After synthesis of aniline by Germans for dyeing of cloths in 1899, cultivation of Indigo plants needed to be revived; therefore Pusa in northern Bihar was chosen as the ideal location. Initially it had five departments: agriculture, cattle breeding, chemistry, economic botany, and mycology. In 1907, the bacteriology unit was added. The institute was shifted to Delhi on 19th July, 1936, as a severe earthquake in 1934 completely devastated the institute. After independence, this Imperial Agricultural Research Institute was renamed as Indian Agricultural Research Institute. University Grants Commission (UGC) gave status of Deemed to be University to IARI in 1958 which marked as beginning and restructuring of modern agricultural education in India.



Fig. 1.8: Indian Agricultural Research Institute, New Delhi

When it comes to agricultural research in India, it has started with the establishment of the “Indian Council of Agricultural Research” (ICAR) on 16th July 1929, as a registered society under the Societies Registration Act 1860 following the recommendation of the Royal Commission of Agriculture (1926). The ICAR is the apex body with its headquarters in New Delhi, which coordinates, directs, and oversees agricultural research and education, including fisheries and animal sciences. Being an autonomous organization under the Department of Agricultural Research and Education (DARE), Ministry of Agriculture and Farmers Welfare, ICAR administers 109 research institutes, 63 agricultural universities, 4 deemed-to-be-universities and 731 Krishi Vigyan Kendras (KVKs) spread out across the nation (www.icar.org.in).

After independence, following the pattern of land grant universities in USA, first state agricultural university of India (Govind Ballabh Pant University of Agriculture & Technology) was established in 1960 at Pantnagar, Uttarakhand. Very soon agricultural universities were developed at other places as well like Bhubaneswar and Ludhiana (1962), Jabalpur (1964), Bangalore (1965). At present, there are 63 state agricultural universities spread all over the India.

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Notes

Major Events in Development of Agricultural Research System in India

1905	Establishment of Imperial Agricultural Research Institute (IARI) in Pusa, Bihar
1926	The then Viceroy of India Lord Linlithgow formed Royal Commission on Agriculture.
1928	Royal Commission on Agriculture submitted its report where they advocated establishing the Imperial Council of Agricultural Research to encourage, direct, and coordinate agricultural research across India.
16th July, 1929	On July 16, 1929, ICAR was established as a registered society under the Societies Registration Act of 1860 based on the Royal Commission of Agriculture's advice.
March, 1946	Under Jogendra Singh's presidency, it was decided to rename the organisation from the 'Imperial Council of Agricultural Research' to the 'Indian Council of Agricultural Research'.
1960	Establishment of first state agricultural university in India
1965	Dr. B. P. Pal, the first Director General of ICAR, started All India Co-ordinated Research Projects (AICRPs).
1966	ICAR was given full autonomy after the recommendation of Agricultural Review Team.
1973	● In the Ministry of Food and Agriculture, a Department of Agricultural Research and Education (DARE) was established. ● In accordance with the Gajendra Gadkar committee's advice, the Agricultural Scientists Recruitment Board (ASRB) was founded on 1st November, 1973 as an independent recruitment organisation. ● The Agricultural Research Services (ARS) was initiated.
President of ICAR: Union Minister of Agriculture, Government of India	
1st President of ICAR: Khan Bahadur Sir Muhammad Habibullah	
Director General of ICAR is also the Secretary of DARE.	

**INTEXT QUESTIONS 1.6**

- Indian Agricultural Research Institute (IARI) was established during the year of
 - 1877
 - 1905
 - 1936
 - 1929
- The Royal Commission on Agriculture was formed by
- The head quarter of ICAR is located at
 - Chennai
 - New Delhi
 - Mumbai
 - Kolkata
- Who was the first Indian Director General of ICAR?
- Initially, the IARI was established at

*Notes***ACTIVITY 1.4**

Take a blank world map. Point out places where ancient civilizations were developed. You may take help of figure 1.1 for this purpose.

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**WHAT YOU HAVE LEARNT**

- The agriculture is the art and science of cultivating the soil, producing crops and raising livestock. The word agriculture derives from the Latin words 'ager' (meaning -field) and 'cultura' (meaning -cultivate), signifying cultivation of field.
- Around 12,000 years ago, agriculture began to take root. Farming had become established by 8000 BC on the banks of the Nile. The transition from a nomadic hunter-gatherer way of life to farming and permanent settlements is known as the 'Neolithic Revolution' or first agricultural revolution.

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- The process of putting plants or animals under human control or taming is known as 'Domestication'.
- The 2nd agricultural revolution, also known as the British agricultural revolution, took place during the mid 17th and late 18th centuries. The major changes occurred during this phase were shift from subsistence farming to cash farming, technical changes like crop rotation and livestock management, increased use of farm machines and fertilizers.
- Green revolution was initiated during 1960s and late Dr. M.S. Swaminathan is known as the 'Father of Green revolution in India'. The development of high-yielding wheat variety seeds and rust-resistant wheat strains were significant advancements in this effort.
- The Green Revolution transformed India from a food-deficient country to one of the world's leading agricultural nations. The basic elements of green revolution were expansion of farming areas, double cropping system and use of improved quality seeds.
- Indian Council of Agricultural Research (ICAR) is the apex body which coordinates, directs and oversees agricultural research and education in India.



TERMINAL QUESTIONS

1. What do you mean by agriculture?
2. Describe how agriculture contributed to the establishment of permanent civilizations.
3. What are the important features of Neolithic revolution?
4. Give a brief account of David Harris model on the origin of agriculture.
5. Discuss the importance of 'Green revolution' in achieving food security in India.
6. What are the drawbacks of green revolution?
7. Match the followings:

A. White Revolution	1. Food Processing
B. Blue Revolution	2. Fruit Production



- | | |
|----------------------|---------------------------|
| C. Brown Revolution | 3. Fertilizer Production |
| D. Grey Revolution | 4. Prawn/Onion production |
| E. Red Revolution | 5. Egg/Poultry production |
| F. Pink Revolution | 6. Fish production |
| G. Golden Revolution | 7. Tomato/Meat production |
| H. Silver Revolution | 8. Milk Production |
8. Write a short note on 'Evergreen revolution'.
 9. Enlist the important steps taken by the British Government to improve the Indian agriculture.
 10. What are the major achievements of India in agriculture after independence?



ANSWERS TO INTEXT QUESTIONS

1.1

1. Latin
2. Option d (11)
3. True
4. Teosinte, southern Mexico
5. Option c (China)

1.2

1. Neolithic revolution
2. V. Gordon Childe
3. Domestication is process of adapting plants or animals for human use.
4. Celts
5. First stage

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1.3

1. 9000 BC
2. Barley
3. Potato, tomato
4. Option d (All of these)

1.4

1. British agricultural revolution
2. Four-course crop rotation, modification of Chinese plough, abolition of common right on land, increase in farm size, land reclamation, selective breeding
3. Third stage
4. Option b (Clover)

1.5

1. Dr. Norman E. Borlaug
2. Dr. M.S. Swaminathan
3. Ford and Rockefeller foundation
4. Punjab (Option b)
5. Milk (option c)

1.6

1. 1905 (option b)
2. Lord Linlithgow
3. New Delhi (Option b)
4. Dr. B. P. Pal
5. Pusa, Bihar

GLOSSARY

Agriculture: Agriculture is the practice of cultivating land, raising crops, and rearing livestock. Agricultural activities include poultry, livestock, fisheries, animal husbandry, dairy farming.

Bio-fortification: Biofortification is a process of improving the nutritional value of food crops.

Celts: Celts are prehistoric tools used by primitive human. These were made up of stone or bronze and similar to an axe or hoe.

Domestication: The process of adapting wild plants and animals for human use is called domestication.

Evergreen revolution: It refers to improvements in crop productivity without harming the environment.

New world: The term new world refers to North, Central, and South Americas, including the Caribbean islands. It was popularized when Europeans colonized the America during 16th century.

Norfolk four-course crop rotation: It is sequential growing of four crops (wheat, turnip, barley and clover) in four-year cycle on a same piece of land.

Old world: It refers continents of Asia, Europe and Africa. It is called old because before discovery of America, people believed there were only continents of Asia, Europe and Africa.

Sali: It is a tall and late maturing variety of rice which contains several medicinal properties. They are specially grown in winter months.

SUGGESTED READINGS

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2. Randhawa, M.S. (1980). *A History of Agriculture in India* (Volume I & II), Indian Council of Agricultural Research, New Delhi.

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Notes

Cultivation of wheat, barley, chickpea, sesame in Indus valley

Prevedic Era

North India

South India

Cultivation of ragi, horse gram and small millets

Cultivation of barley, sesame, bajra, millet, lentil

Vedic Era

Rice was commonly grown

Cultivation of beautiful flowers during mughal era

During Dynasties

Introduction of potato, tomato, maize, ground nut by Portuguese.

British Era

Indigo cultivation

Recurrent famine

Mesopotamia

Egypt

Indus valley

China

Aztec and Maya

Greece

WHAT YOU HAVE LEARNT

1877 - 1st agricultural college at Saidapet
1905 - Indian Agricultural Research Institute (IARI)
1929 - Indian Council of Agricultural Research (ICAR)
1973 - Dept. of Agricultural Research and Education

Agricultural Education in India

Ancient Civilization based on Agriculture

Evolution and Development of Agriculture

Agricultural development in India

Agricultural Revolution

British Agricultural Revolution

British Agricultural Revolution

Neolithic Revolution

Expansion of farming areas

Double cropping

Use of high quality seeds

Food Preservation

Domestication of Animal and Plant

Pottery

Norfolk Four course Crop Rotation

Modification of Chinese Plough

Land Conservation and Reclamation

Wheat, Barley, Pea, Rice, Millet

Cattle, Goat, Sheep, Pig