UNIT 1 EVOLUTION, SCOPE AND DIVERSITY OF AGRICULTURE

1.0 OBJECTIVES

After reading this unit, you will be able to:

• describe the changes in agriculture since the inception of civilization till today;

• explain the change in farming systems involving crop production, animal husbandry, poultry, fisheries, piggeries, agro-forestry etc.;

• explain the changes in practices of crop-management; and

• discuss the modern site-specific agricultural production technology for sustainable agriculture with special reference to changing global needs.
1.1 INTRODUCTION

The word ‘agriculture’ is derived from the two Latin words ‘Ager’ referring to the soil and ‘Cultura’ referring to the cultivation. Thus, agriculture is a very broad term encompassing all aspects of crop production, livestock farming, fisheries, poultry, forestry etc. Agriculture started with the civilization of human beings. All primary necessities of human life viz., food, clothing and housing are directly related with the agriculture. At present agriculture are the main profession and the most important human economic activity worldwide. It differs from other industries being a biological process. Soil, water, air, seeds, land and peasants are the six major pillars on which agriculture is based. The physical environment of soil, water and air are the resource base.

The principal objective of agriculture is to channelise as much as possible the energy from incoming solar radiation into crops and/or livestock through efficient management practices as well as to minimize that is used by such potential competitors as weeds and pests. The physical resource base determines the level of use to which land can be most economically put to agriculture at a particular time. The natural variability of the physical environment makes agriculture one of the most unpredictable human activities. Soil, climate and plants are three major components of agriculture. In the absence of any one of these, agriculture is not possible. Growing plants in the existing land base under prevailing climatic conditions is basically agriculture. Both soil and climate together make the environment which influences the completion of plant life cycle. Environment of plants constitutes both soil and aerial, as root portion of plant is inside the soil and shoot portion of plant is exposed to the aerial atmosphere. Soil environments are amenable for manipulation or modification through tillage, irrigation, fertilizer application etc. The physical environment of soil comprises of soil air, soil water and soil temperature, while soil pH, electrical conductivity, and concentration of nutrients (minerals) constitutes the chemical environment. The soil biological environment is constituted with the presence of living organisms both flora and fauna called soil micro-biota. The aerial environment includes solar radiation, rainfall, temperature, relative humidity and wind velocity.

Basically, plants convert the environmental inputs like solar energy, carbon dioxide, water and soil nutrients into economic products in terms of human or animal food or industrial raw materials.

1.2 EVOLUTION

In this section, we will study the various phases of agriculture development over the period. Let us discuss the agriculture development under the following sub heads.

1.2.1 History of Indian Agriculture

India was the pastoral country before agriculture started. Concurrently, development of crops and animals took place leading to the emergence of various types of farming systems that are now seen in different parts of the country.

Most important contribution of India towards development of agriculture is the cultivation of rice which is now staple food of south, south-east and east Asia.
Sugarcane, several legumes and tropical fruits like mango are also native of India. Mohan Jodaro to Harappa territory was the centre of agricultural revolution in Indus valley during the period 3000-1700 BC. The scene of this revolution was in the countries between river Nile and Ganges. Excavations in this area have revealed huge granaries. Barely, wheat, sesameum, peas, cotton, mustard, date-palm and lentil were the main crops during the period. Wooden plough and wheeled cart were in use. Harappans knew ginning, spinning and weaving of cotton into cloth. Farmers used sling-boll for scaring birds, cattle, buffalo, goat, sheep, pig, camel, ass, dog and cat. These have special mention in the list of domesticated animals.

About 1800-1600 BC, Aryans migrated to India and got mixed with the Harappans. Horses were the main domesticated animal besides cattle. Agriculture was the most important profession during Vedic age (1500-1000 BC). Use of iron implements, particularly iron plough became prevalent. Besides, barley, wheat, beans, sesameum, millets and rice are frequently referred in Vedas. The importance of trees is mentioned during Budhist period (600 BC). The importance of sowing season, climate, cloud, soil fertility, irrigation and weed control has been emphasized several times in Mahabharat and Ramayyan during the period 1000 and 500 BC, respectively. Irrigation from rivers, lakes and reservoirs has also been mentioned.

During first century of Christian era and 300 AD, cultivation of rice with irrigation from Cauvery river was the most important event in Indian agriculture. After 300 AD, during the period of Chandragupta II, Amarkosha was written, in which there is mention of classification of soil and land use, irrigation, implements and use of manures. Rice transplanting was practiced till that period besides cultivation of several field crops, vegetables and fruits etc.

During Kanuj Empire of Harsha (606-647 AD), fine scented rice was grown in Magadh. Pomegranates and sweet orange were also grown during this period. There is mention about land manuring, crop rotation, irrigation, tillage, implements, crop protection and meteorology in the book “Krishi Parastra” written during 950-1100 AD. Several water reservoirs were made during the period 1336-1646 AD and irrigation channels were constructed and ‘Anantaraja Sagar’ in Vijayanagar district of A.P. (1337 AD) is one example. Later Babar laid the foundation of Mughal dynasty in India. Except for gardens, flowers and provision of irrigation mainly in South India, there was nothing special about agricultural development. The peasants became disinterested in agriculture because of large sum extracted from them as peasantry (tax).

1.2.2 Agriculture in Prehistoric Era

Since agriculture fulfils the need of food to human and animal, it appears to be a very primitive step of human civilization. The earliest man (Homo erectus) emerged around one and half million years ago and spread throughout old world tropics and later to temperate zones. About 500 thousand years ago, he probably learnt to control and use fire. The earliest man was distinguished from fellow animals by his intelligence and skill in making tools and selection for self use.

Homo sapiens, the direct ancestor of modern man lived 250 thousand years ago. Homo sapiens, the modern man, appeared in Africa 35 thousand years ago. He was distinguished from all other extinct species of genus Homo, by large brain, small teeth and chin and capacity for making and using tools. He hunted a variety
of animals and cooked their meat on fire. The weapons for hunting were boulders and spears of wood tipped with blades of flint. He also used stone-tipped arrows. Later, he domesticated the dog, which greatly helped him in hunting. Apart from the meat, he gathered a variety of seeds, leaves, fruits, roots, and other parts of plants from the forest for food. He had no control over food supply and was unable to cloth and shelter adequately. During the period 8700 BC to 7700 BC, he domesticated animals and turned a herdsman. He first domesticated sheep and later goat. Between the period 7500 BC to 6500 BC, man gradually shifted from hunting towards agriculture. Stone axes were used for cutting trees and fire for burning forests. Agriculture has no single and simple origin. It was started in different parts of the world during different periods. The evolution of agriculture took place gradually with the changes in human civilization, mostly based on the experiences. The exact evidences are not known about shifting of man into agriculture from hunting and gathering of animal for food. The hunting and gathering food was difficult job to collect the food for each individual, while pastoral life and agriculture could support to a group. Thus, residing in group or camps and dependency of food on plants had started in human civilization. It is expected that pre-historic agriculture might have developed in several steps as under:

a) Conservation of Desirable Native Plants

By using various parts of plants like roots, seeds, leaves, flowers, fruits, etc., probably man have identified the desirable plants which he referred as crop plants and later he might have tried to conserve those plants from danger.

b) Collection and Preservation of Seeds

After eating the fruits, man would have thrown the seeds elsewhere and they have seen the germination of same type of plants from thrown seeds. With this experience they might have learned and decided to grow these plant by using the collected and preserved seeds at desirable place. In this way they would have started the collection and preservation of seeds of useful plants.

c) Sowing of Seeds

With the increase in population, when man would have faced shortage of foods, they might have started sowing on the basis of climatic suitability.

d) Tilling of Land

When birds or air or flow of water damaged seeds, they might have thought to loose the hard soil surface with the help of stone or wooden tools putting the seeds inside the soil to avoid the damages.

e) Shifting Cultivation

After continuous growing of same plants for a long time, they might have observed poor growth in plant and finally the yield. Thus, they might have left the land by using another land for growing the plants. Initially, there were enough land for raising the crops/plants and when they found reduction in the yield on the same land, then they might have shifted their farming in other newly acquired land by leaving the old land and living places. This system of farming is referred as shifting cultivation and is followed in some tribal belts of Africa and Asia.
f) **Weed Control**

Farmers in ancient age might have seen growing several unwanted plants with the desirable plants competing with them for growth resources. With this experience, they might have started control of these unwanted plants (weeds) from the fields by uprooting or cutting etc. Women mostly performed this work from the very beginning.

g) **Fallowing of Land**

With the gradual increase in the population, people have probably started living in groups together and established villages with some economic management and then practice of shifting cultivation would have been avoided. On experiencing the reduction in yield due to continuous raising of a crop plants on the same soil, they might have started fallowing of some portion of land and tilling of old fallow land with unwanted green plants. Then they might have experienced good yield from the fallow land.

h) **Use of Domestic Wastes as Plant Nourishment**

By the use of domestic wastes in agriculture as plant nourishment, people must have experienced the good growth of crop plants. Then they might have started to preserve these wastes and use them in the cropped land as manure. Meanwhile, they might have domesticated several animals like sheep, goat, cow and buffalo etc., for their support and then they must have seen tremendous effect of dung, urine and animal wastes in improving the soil fertility. Thus, they had started use of ashes, domestic wastes, animal dung and urine and animal wastes in the process of agricultural production.

i) **Following Crop Rotation**

In due time, the cultivators must have realized that growing cereals after legume crop give better yield which resulted in crop rotation practice. Later they must have known that legume plants fix atmospheric nitrogen through their root nodules.

j) **Green Manuring**

Later with this experience, legumes must have been grown and then turning them into the soil with the help of available equipments to improve the soil fertility.

The important events in the history of agriculture after 7500 BC, can be listed as below:

<table>
<thead>
<tr>
<th>Period</th>
<th>Event</th>
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<tbody>
<tr>
<td>7500 BC</td>
<td>Conservation of crops (wheat, barley).</td>
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<tr>
<td>6000 BC</td>
<td>Domestication of cattle and pigs.</td>
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<tr>
<td>4000 BC</td>
<td>Cultivation of maize.</td>
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<tr>
<td>3500 BC</td>
<td>Cultivation of potato.</td>
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<tr>
<td>3400 BC</td>
<td>Wheel was invented.</td>
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<tr>
<td>3000 BC</td>
<td>Bronze was used to make tools.</td>
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</table>
2900 BC Plough was invented and irrigation started.
2700 BC Silk moth domesticated.
2300 BC Cultivation of chickpea, pea, mustard and cotton. Domestication of fowl, buffalo and elephant.
2200 BC Cultivation of rice in India.
1200 BC Cultivation of finger millet (ragi).
1725 BC Cultivation of sorghum.
1700 BC Taming of horses.
1500 BC Cultivation of sugarcane and irrigation from wells.
1400 BC Use of iron.
1500 AD Cultivation of sweet orange, sour orange, wild brinjal, pomegranate.
1600 AD Introduction of several crops in India from Portugal-like, sweet potato, arrow root, cassava, tomato, chillies, pumpkin, papaya, pineapple, guava, custard apple, groundnut, cashewnut, tobacco, American cotton, rubber.

1.2.3 Development in Agriculture before Independence

The Europeans, primarily the Britishers, arrived in India in early seventeenth century and by the 18th century had made a profound impact on India. India was forced, for the first time into a coordinate role within a world system based on industrial production rather than agriculture. Many of the dynamic craft and cottage industries that had long attracted foreigners to India suffered extensively under competition with new modes of mass production fostered by the British. Modern institutions, such as universities and technologies, rail lines, roads, mass communication were developed to serve British, rather than Indian, economic interest. A country, that in the 18th century was a magnet for trade, by the 20th century, became an underdeveloped and over populated under alien domination.

Land ownership was given to small group of people to collect the rent from individual farmers and pay to the Government, a system known as ‘Zamindari’. There was also ‘Rytwari’ system in which the ruler used to collect rent directly from farmers, who had settled on the land. Farmers had no security of possessed land hence they had no interest in land development. Irrigation schemes were initiated in major river deltas for raising additional revenue.

A separate Department of Agriculture was created at national level in 1871. Some of the provinces (now states) also created independent Agriculture Departments. Facilities for agricultural education were created at Coimbatore in 1878 and Pune in 1890. After the great famine of 1876-77, a Famine Commission was appointed in 1880. Dr. J.A. Voelekar, Consultant Chairman of the Royal Agriculture Society submitted report on improvement in Indian agriculture in 1891.

In the first decade of 20th century the Empirical (Now Indian) Agricultural Research Institute was set up in 1905 at Pusa (Bihar). Subsequently, agricultural colleges were started at Coimbatore, Pune, Nagpur and Kanpur. Royal Commission (1926)
report was accepted in 1928. Department of Food was created in 1942 in order
to meet the food requirement. Grow More Food Campaign, Food Policy
Committee, Famine Enquiry Committee and Fertilizer Production Programme
were initiated. In January 1946, Statement of Agriculture and Food Policy in
India was issued with 10 objectives to promote welfare of the people and
improvement of their standard of living. Steps were taken to organize research
supports to agriculture through research institutions.

1.2.4 Development in Agriculture after Independence

During the post independence, extension of agricultural education in country
has witnessed a sea change both in content and quality, in view of changed
scenario of agriculture. On the recommendation of the Education Commission
(1948), Joint Indo-American teams of 1955, 1959 and 1961 and Education
Commission (1964-66), State Agricultural Universities (SAUs,) were established
to integrate agriculture education, research and extension activities in the country
through State Governments. At present 43 SAUs, 4 Deemed Universities and
one central agricultural university besides about 40 Faculties of Agriculture in
traditional universities with the enrolment capacity of nearly 6400 in agriculture
and 1500 in veterinary science in graduate, masters and doctoral courses exist.
These institutions include agriculture, veterinary science, agricultural engineering,
forestry, dairy technology, food technology, horticulture, fisheries, home science
and agricultural marketing. The seventh schedule of the constitution of India allocated
the responsibility of agricultural education, research and extension functions to the
Union and State Governments. The Indian Council of Agricultural Research
(ICAR), as the apex agency, is responsible for the growth and development of
agricultural education and research in India. The ICAR coordinates research in
the country through its wide network of National and Central Research Institutes
(48), National Research Centers (30), Project Directorates (12), All India
Coordinated Research Project (61) and other projects / programmes (16).

1.2.5 Modern Indian Agriculture

Modern agriculture developed with the advancement of science and technology
and its practical application in the field of agriculture. Now farmers are adapting
new techniques of agricultural production by replacing the traditional practices to
harness the high level of productivity. Consequently, the productions of different
kinds of produce at national level are quite satisfactory to meet the current needs
of the human being and livestock. Such achievement in maintaining the pace in
agricultural production with the growing population of human and cattle are mainly
contributed due to the following facts:

a) Development of Improved Plant Types/Varieies

After 1960, vast improvement in crop varieties has been made. Introduction
of high yielding varieties responding to better management particularly in
wheat and rice and hybrids in maize, sorghum, pearl millet, cotton and
several vegetable crops have made tremendous positive change in agricultural
production. Varieties resistant to many diseases and insect-pests are available.
Now the crop varieties superior in grain quality, high oil contents, high quality
of fiber, as well as tolerance to abiotic stresses like drought, floods, frost,
high temperature etc., are also available. The crop varieties of varying
duration (early, medium and late) have encouraged growing of these crops in
varied agro-climatic conditions and cropping/farming systems.
b) Development of Improved Crop Production Technologies

Improved production techniques for crop cultivation based on the availability of various resources viz., land, water, capital and farm machineries have been developed. Improved production technology includes selection of suitable crops/varieties, proper land preparation, efficient sowing management (sowing time, seed rate, sowing method and plant geometry, etc.), balanced nutrition, effective weed control, adequate water management and proper plant protection measures. Thus, now agriculture itself is an industry.

c) Minimum/Zero Tillage

Earlier, it was considered that more yields are possible with more tillage, but now this idea has been changed. Now growers try to utilize the rich nutrition of upper soil surface and soil moisture more efficiently by minimizing or not doing the tillage operations.

d) Intensive Cropping

In the past, mono cropping and double cropping under rainfed farming were considered ideal for crop production. Now due to availability of early maturing high yielding varieties and efficient soil moisture conservation techniques, several double cropping systems have been evolved. Growing of three or more crops in a succession even without giving the rest to land became quite feasible to raise the returns per unit area and time. Many studies found that, intensive cropping systems have no adverse effect on soil properties.

e) Dryland Agriculture

In the areas where evapo-transpiration is greater than precipitation, growing of crops was risky but now improved cultivation technology for growing suitable crops has been developed. Now, it is said, that soils of dry farming regions are more hungry than thirsty.

f) Use of Problematic and Waste Land in Agriculture

The problematic soils like saline, alkaline, acidic, flood prone, desert and other soils unsuitable for agricultural use are being reclaimed with suitable scientific technologies for their efficient use in agriculture.

g) Maintenance of Soil Health

It is well known that soil is a medium for plant growth to give ultimate yields. Hence, any operation on the soil for agriculture viz., tillage, manuring, fertilizer application, irrigation, drainage, weeding, interculture practices and use of agro-chemicals may be done taking due consideration about their influence on soil-properties.

The old philosophy of Indian farming is getting changed and modern improved agro techniques for growing crops are being adopted.

1.2.6 Global Issues Related to Agriculture

Improvement in food and nutritional security would not be the major issue for agricultural development in India, but emphasis for environmental protection, sustainability and profitability would be more important in future to come. Following the General Agreement on Trade and Tariff (GATT) and liberalization process,
globalization of markets would call for competitiveness and efficiency of agricultural production.

Check Your Progress 1

Note: a) Use the spaces given below for your answers.
   b) Check your answer with those given at the end of the unit.

1) Discuss the historical sketch of primitive agriculture in the country.


2) Summarize the development of Indian agriculture after independence.


1.3 SCOPE

Indian agriculture has now entered in a dynamic phase. The innovation of new seeds, use of farm chemicals and irrigation water had lead to “Green Revolution” after 1970. Presently, in the context to rapid agro-economic changes and globalization of system, a more complete development approach is needed. It should not only concern with producing competitive and quality farm produces, but also address issues of natural farm resource management, environmental support to farming and institutionalizing development linkage. Agricultural achievements in India during its 50 years of independence have been positive and changed the image of the country from food importer to potential exporter. However, in India population is growing at the rate of 1.9 per cent annually and reached to 1.2 billion in the year 2005. To keep pace with current rate of population growth and consumption patterns, the requirement of food grains will reach to 246 million tones by the year 2020. There is a need to reduce crop losses from pests, diseases and weeds and to promote fertilizer use efficiency to further increase the agricultural production.

India is a leading agricultural country in the world. Presently, agricultural production (food grains, edible oils, pulses, vegetables, fish, milk, sugar, fibre and feed) is almost satisfactory to meet the current demand. But the estimates of requirement of food, feed, fibre and raw materials towards the middle of 21st century are likely to be doubled. The current trend of population growth has created alarming situation as the scope of increasing in area under cultivation is not possible besides possibility of reduction in area due to urbanization and infrastructural development. Thus, there is urgent need to accelerate the pace of agricultural growth in order to fulfill the expected needs.

Indian agriculture has a wide scope to serve the human being with reference to following aspects:
1.3.1 Food Security

Advancement of civilization is closely related to agriculture. As 21st century has commenced it is high time to start anticipating challenges to be faced with their solutions. Strategies are to be worked out to enhance agricultural production under all odds. The future requirements must be worked out looking into changed food habits and change in standard of living. Vertical increase in the productivity appears to be solution to double the agricultural production. Therefore, cultivation of high yielding varieties with improved production technologies, efficient use of the available resources, including farm machineries and power, efficient use of agro-inputs, must be well known to the farmers. Proper training to the farmers and concerned persons is a must.

1.3.2 Efficient Use of Knowledge of Agricultural Sciences

In pre-scientific agriculture, 6 persons could produce enough food for themselves and for 4 other persons. In years of bad harvest, they could produce only enough for themselves. With the development of agricultural science and application of advanced technology, 5 persons are able to produce enough for 95 others besides themselves.

Agriculture as a science is derived with the integration of the knowledge of biology, physics, chemistry, economics, social science, geography, geology, agro-meteorology and engineering. There is tremendous development in the knowledge of these subjects. A good coordination is required to have multidisciplinary approach to advance the agricultural resources. Biotechnology and genetic engineering are important in evolving crop varieties with desired characters for future use.

1.3.3 Efficient Use of Natural Resources

The natural resources affecting over all atmosphere of crop plants should be efficiently used. At present, the available solar radiation, water, air, CO<sub>2</sub> etc., are underused in the field of agriculture. Most of the improved varieties are sensitive to light and they synthesize their food from the light. The plants use only a small portion of radiant energy and huge amount of available radiant energy remains unused. Mostly upper leaves of the many plants get advantages of light, while lower leaves remain without light. Thus, distribution of light is uneven to the plant. Therefore, such plant types should be evolved or planting geometry may be developed, so that crop plants may utilize light more efficiently.

Soil and water are the other natural resources, which are used without proper attention. The management of soil according to land use capabilities, involving proper tillage, irrigation, checking of erosion, avoiding water logging, balanced manuring etc., leading to profitable crop production. The prevention of land degradation, conservation of rain water, irrigation with higher water use efficiency, maintaining the quality of water, improving the ground water potential for improving the productivity of crops under both irrigated and rainfed production systems is needed.

1.3.4 Development of New Plant Types

As mentioned above, the crop canopies are not suitable to utilize the radiant energy efficiently, hence there is need to evolve such plant types in crops in future, which may be able to utilize the radiant energy maximum. For this purpose, the leaves of plants may be semi erect or erect with narrow lamina rather to drooping
with broad lamina. The size of plants to be reduced with more economic yielding ability and thus, harvest index will be high. The small plants may be responsive to high level of fertilizer application and irrigation supplies resulting in high yields. The histology of plants may also be changed in future. At present, 33 per cent of synthesized food of plant is utilized for growth, but now it is discovered that more food material can be consumed by respiration through green tissues and it is known as photorespiration. The crops having ability of photorespiration result in poor photosynthesis owing to less yields. Therefore, now such plant types may be evolved, which have less or no photo-respiration.

1.3.5 Development of Multiple Resistance Crop Varieties

With the advancement in biotechnology and genetic engineering, such varieties may be evolved, which have resistance against adverse effect of several biotic (insect-pests and diseases) and abiotic (climatic and cultural practices) stresses.

1.3.6 Commercialization of Agriculture

The agriculture is not related only for arranging foods and other livelihoods, but it is a profession for raising the socio-economic status of an individual farmer as well as the nation. India has potential to become the world's largest exporter of agricultural products and also to become fourth largest economy after the USA, Japan, and China by the year 2020. However, failing on the farm front and not orienting its agricultural practices towards greater food production would mollify its prospects. Though there has been vast change in Indian agriculture resulting in self-sufficiency of food, it is entirely a self-contained system with the seed coming from the previous harvest, manures from the farm wastes and labour from the joint family, while produce is meant primarily for family consumption. The occasional surplus in agricultural production due to favourable weather conditions is saved for lean year. After this, country has forced towards surplus farming, making use of the new agricultural technology as well as agro inputs (seeds/fertilizer) developed by own or collected from external origin. In addition to this, the recent trends of liberalization and globalization are pushing farmers into global market competition. Thus, commercial agriculture has become insurable. At present on an average majority of Indian farmers are unaware about international market. Therefore, adequate efforts are needed to equip them for this purpose by building managerial confidence in farmers for commercial farming, development of adequate infrastructure for promoting commercial farming and making cooperative efforts for developing marketing and market intelligence.

1.3.7 Sustainable Agriculture

After the independence, there was great challenge before the nation to achieve self-sufficiency in food grain production which has been achieved within a short period by following several strategies viz., expansion of area under crop, development of water resources for irrigation, development of policies for input supplies, markets infrastructure and evolution of high yielding varieties responsive to higher input etc. But increase in agricultural production has created many problems pertaining to land degradation, pesticide residues in farm produce, gene erosion and atmospheric as well as water pollution in some areas.

Sustainable agriculture is a form of agriculture aimed to maintain the pace of agricultural production with the burgeoning population without endangering the
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resource base of the future generation. Dependence on the use of synthetic fertilizers, pesticides, and other agro-chemicals to raise the vertical productivity is posing threat to ecologically fragile environment. Use of more irrigation water is looking serious challenges and meanwhile, injudicious use of irrigation is creating many serious problems in soils. Thus, sustainable agriculture is a balanced management system of renewable resources including soil, wildlife, forests, crops, fish, livestock, plant genetic resources and ecosystem without degradation and to provide food livelihood for current and future generation by maintaining or improving the ecosystem services of these resources. The sustainable agriculture system has to be economically viable, environmentally sustainable both with short and long term perspectives. Natural resources not only provide food, fibre, fuel and fodder, but also perform ecosystem services viz. detoxification of noxious chemicals within soils, purification of water, favourable weather and regulation of hydrological processes within watersheds. It has to prevent land degradation and soil erosion. It has to replenish nutrients and control weeds, pests and diseases through biological and cultural practices. Thus sustainable agriculture can be based on natural farming or organic farming.

The sustainable agriculture substantially differs from modern agriculture as under:

<table>
<thead>
<tr>
<th>Particular</th>
<th>Sustainable Agriculture</th>
<th>Modern Agriculture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management of plant nutrition</td>
<td>Using FYM, composts, green manures, biofertilizers, oilcakes, crop residues and agro-waste.</td>
<td>Fertilizers.</td>
</tr>
<tr>
<td>Pest control</td>
<td>Crop rotation, cultural methods and biological methods.</td>
<td>Use of toxic chemicals.</td>
</tr>
<tr>
<td>Use of resources</td>
<td>The rate of extraction from forests, fisheries, underground water and other renewable resources do not exceed the rate of regeneration.</td>
<td>The rate of extraction exceeds the rate of regeneration besides pollution of water bodies.</td>
</tr>
<tr>
<td>Quality of food materials</td>
<td>Food materials are safe.</td>
<td>Food materials may contain toxic residues.</td>
</tr>
</tbody>
</table>

The following practices are needed for sustainable agriculture:

1) Soil and water conservation to prevent degradation of soil productivity and increasing crop growing period for optimum crop productivity.

2) Efficient use of limited irrigation water.

3) Crop rotations that mitigate weeds, diseases and insect problems, increase soil productivity and minimize soil erosion.

4) Integrated nutrient management that reduces the need for chemical fertilizers, improves the soil health, and minimizes the environmental pollution by conjunctive use of organic, inorganic and biofertilizers.

5) Integrated pest management that reduces the need for agro-chemicals by crop rotation, weather forecasting, use of resistant varieties, timely sowing and biological pest control.
6) Integrated weed management by adopting preventive measures, tillage, timely interculture, intercropping and crop rotation to improve soil and plant health.

1.3.8 Risk Management in Agriculture

Risk has always been a part of agriculture. But presently successful farmers are now looking at a deliberate and knowledgeable approach to risk management as vital part of their game plan. Risk management means farming with confidence in a rapidly changing world. It is the ability to deal with risk that comes with new, attractive farming opportunities. Generally, in agriculture one has to manage production, marketing and financial risks to achieve expected outcome/profit from agriculture. Presently computer based modules have been developed which helps in reducing the risk in agriculture.

a) Production Risks

The major sources of production risks are weather, pests, diseases, the interaction of technology with other farm and management characteristics, genetics, machinery efficiency and the quality of inputs. Some of the risk management strategies like enterprise diversification, crop insurance, contract farming and alternate technologies are adopted so as to reduce production risks.

b) Marketing Risks

Marketing is the part of business that transforms production activities into financial success. Unanticipated forces such as weather or government action may lead to dramatic changes in crop and livestock product prices. To be successful, one takes an informed and balanced approach for making marketing decisions by focusing on long-term profitability. Academic studies indicate that marketing strategies that depend on price chasing or speculation have not been shown to be consistently profitable. Also, those strategies that do not consider financial and production risks is likely to prove poor. Managing marketing risk begins with a marketing plan. The goals and objectives of business derive marketing plan. An accurate understanding of production costs is a critical part of a sound marketing. Beside this, better knowledge of supply and demand, of agricultural commodities in local market/area and average prices received in previous years are important considerations for developing market plans.

c) Financial Risks

Financial risk has three basic components mainly the cost and availability of debt capital, the ability to meet cash-flow needs in a timely manner and the ability to maintain and grow equity. A set of well-maintained financial records is an absolute necessity for better financial control of a farm. Essential financial statements like balance sheet and statement of owners equity, income statement and projected and actual cash-flow, provide a history of your business and the data one needs to calculate financial performance. Ratios such as dept to asset, dept to equity and turnover are important in monitoring over all performance and in turn lowering the financial risk in agriculture.

1.3.9 Organic Farming

India has made tremendous progress in agricultural production after the inception of green revolution in mid sixties and achieved self sufficiency in food grain
production within a period of 3-4 decades. But on the other hand, it also led to
development of many problems like decline in fertility and productivity of soils,
soil salinization, water logging and appearance of micro nutrients deficiency due to
addition of major nutrients through fertilizers only. Besides, the stagnation in yield
of major field and vegetable crops, human and animal health hazards and unsafe
agricultural produce etc., are some of challenges which forced the scientists/
planners/policy makers/farmers to switch from chemical intensive farming to organic
farming. Organic farming is a new production system which involves the use of
locally and naturally available materials to cater the need of production system
while conserving resources and improving the quality of environment and agricultural
produce. India has so far nearly 2 million hectare area under organic farming and
in the years to come the area may grow due to refinement in production technology
as per national/international standards, certification and value addition of organic
produce.

1.3.10 Post-harvest Management

The post-harvest management plays an important role in improving the quality,
storability and finally the economic value of agricultural commodities. With the
advent of World Trade Organisation, the farmers are realizing the importance of
post harvest management in agriculture because the peasants get excellent economic
returns from their produce, if they have better knowledge of growing conditions
and production practices that promote post harvest quality of agricultural produce.
Quality of agricultural produce cannot be improved after harvest, only maintained;
therefore the crops are to be harvested at the proper stage, later threshed and
winnowed in due course of time. The produce, thus obtained is stored properly at
nearly 10 per cent moisture. The value addition of the produce is done through
grading and making small pack of rice, wheat etc., to improve quality and prevent
physical damage to produce and ease in handling. The perishable crops particularly
potato are refrigerated in cold storage to retard the undesirable growth such as
sprouting and sold in the market so as to get higher price of the produce.

Check Your Progress 2

Note: a) Use the spaces given below for your answers.
b) Check your answer with those given at the end of the unit.

1) Discuss the future thrust for food security with the efficient use of natural
resources.

2) Describe the scope of commercialization of agriculture.
3) Give your comments on post-harvest management

1.4 DIVERSITY

The diversification towards need based cropping system by replacing conventional cropping system is essential for efficient utilization of available agro-resources viz., land, labour, water, farm machineries, managerial capabilities etc. Growing of need based crops in non-conventional season and area should be explored. Now, the use of land to grow only crop(s) is not sufficient to meet the livelihood of farmers. Farmers cannot satisfy their all needs by growing crops only even in the intensive manner, but they need several other components viz., milk, meat, eggs, medicines, fuel, fodder, woods and manures etc. Thus, there is need to exploit available diversities to make farming more sustainable and therefore, farming system approach is essential for successful agriculture in present day and future also. Farming system approach is applied to agriculture for efficient utilization of all resources, maintaining stability in production and obtaining higher net returns. Farming system consists of several enterprises viz., crop-husbandry, dairying, piggery, poultry, fishery, bee-keeping etc. These enterprises are inter-related. The end products and wastes of one enterprise are used as inputs in others. The wastes of dairying like dung, urine, etc., are used for the preparation of organic manures which is an input in cropping systems.

Farming systems represent an appropriate combination of different farm enterprises for increasing profitability of farms. They interact adequately with environment without dislocating the ecological and socio-economic balance on the one hand and attempt to meet the national goals on the other. The integration of alternate farming system based on the needs of the farmers, national as well as global markets and ecological balance may be the best option of diversification in agriculture.

1.5 LET US SUM UP

Attempts have been made in this unit to explain the meaning of agriculture and its importance in relation to civilization of human being. Under the head of evolution, the changes in agriculture based on the experiences by following farming practices and development in socio-economic status of human are described. The status of primitive (pre-historic era) agriculture and then advancement in agriculture during pre and post independence of the nation are mentioned here. Finally, the modern status of agriculture and its relevance to present changing scenario is explained for the knowledge. The future thrusts of agriculture are mentioned for further advancement to meet the challenging task of food security in future. The possibility
for alternate farming system to raise the socio-economic status of mankind without deteriorating the natural resources and disturbing the ecological balance are also described.

### 1.6 KEY WORDS

**Homo Sapiens**: The direct ancestor of modern man.

**Organic Farming**: It is production system which involves the use of locally and naturally available materials to cater need of production system while conserving resources and improving the quality of environment and agricultural produce.

**Risk Management**: Risk management means farming with confidence in a rapidly changing world.

**Sustainable Agriculture**: It is a form of agriculture aimed to maintain the pace of agricultural production without endangering the resource base of the future generation.

**Zero Tillage**: Planting crops without doing tillage operation.

### 1.7 SOME USEFUL BOOKS/REFERENCES


### 1.8 ANSWERS/HINTS TO CHECK YOUR PROGRESS

**Check Your Progress 1**

1) Your answer should include the listing of important Agricultural Development during 7500 BC to 1600 AD.

2) Extension of Agriculture education, establishment of SAUs, development of research and extension system, development of improved crop production technologies, etc., are important.
1) Prevention of land degradation, conservation of rain water, irrigation with higher water use efficiency, maintaining the quality of water, improving the ground water potential for increasing food production.

2) Agriculture is not only to provide foods but it is a profession for raising the socio-economic stands of the people of country. Indian agriculture has great potential for exports and food processing industries.

3) Post-harvest management is important for improving the quality, storability and economic value of agricultural production.