UNIT 20 SCIENTIFIC POSSIBILITIES AND SOCIAL REALITIES

Structure

20.1 INTRODUCTION

In the previous unit you have studied about food and agriculture. After studying that unit, you might have realised that it was due to constant inputs from science and technology, that we have had a number of breakthroughs in agricultural production. So, we presume by now you have a good background on the subject. In this unit we intend to discuss with you certain, rather specific, issues pertaining to agriculture. We also wish to impress upon you that, though there has been considerable progress in this field, yet its benefits are not available to a large section of our people. Even today, there are several million mouths that are unfed. The challenge is far too big for us. Therefore, it is necessary that we know what is it that hampers the benefits of our progress from reaching all sections of our people. And also how the application of modern technology coupled with the changes brought about in our social outlook can improve the prevailing situation.

Objectives

After studying this unit, you should be able to :

- discuss how application of scientific knowledge has made better agriculture possible under difficult conditions,
- outline the problems associated with modern agriculture,
- explain why there is a mismatch between man's scientific ability to produce and social incapacity to utilise,
- realise the importance of biotechnology.

20.2 AGRICULTURE IN SPECIAL AREAS

Ours is a country of diverse climates and varieties of soil, affording scope for diversity in agriculture. All the year round, agricultural activities continue in one or the other part of the country. Because of the increasing demand for food, the regions which were once considered difficult, if not impossible for agricultural purposes, are now being brought under cultivation. In such regions, some of the factors such as moisture, right temperature, etc., required for the usual crops, are not available. Therefore, plants that could withstand these difficult conditions are grown here, and similarly, the hardy animals are reared in these areas. In this section, we shall discuss three such special areas.

20.2.1 Arid Zone

The chief arid areas of our country are confined to Rajasthan, Gujarat, Haryana, Karnataka and Ladakh. They cover an area of about 400,000 square kilometers. Of this, Ladakh has a cold desert spread over 70,000 square kilometres.

Here, aridity and low temperature limit the agricultural season to about five months in a year. Therefore, crops which require a short period to mature and can withstand severe cold are grown. These are some cereals, oilseeds and fodder crops. Amongst animals, the Pashmina goats, whose hair are in great demand for producing shawls and apparel, can be profitably reared in Ladakh. It is also the only place where the two-humped, Bactrian camel occurs in our country. The animal is used for short-distance transport and it provides milk, meat and wool in the cold desert. It, however, needs immediate protection and special efforts to breed, because hardly 56 specimens are now in existence.

In the hot desert regions, of Rajasthan, Gujarat and Haryana, there is abundance of sunshine which causes high rate of evaporation. Many of these areas, however, have adequate reserves of ground-water which need to be scientifically tapped. In these areas, the rainfall is highly unpredictable and it varies from 100 to 450 mm. Nevertheless, many excellent breeds of cattle, sheep and goats are found in these regions. At many places, the cattle even out-number human population. This region is also endowed with very well-adapted grasses and trees, and the lands are amenable to management. While the population of grazing animals is increasing every year, the area used for grazing is decreasing because more and more of it is diverted for raising crops. There is a need to reverse this trend which is likely to disturb the ecological balance. Now, let us see, how these areas can be utilised for growing plants useful to us, and which plants are most suited for this place. In the arid zone, there is also considerable scope for growing fruit-trees like ber and pomegranate and fuel-wood yielding trees like *Acacia* (Kikar), *Prosopis* (Mosquite) and *Eucalyptus* (Safeda). In such areas, large scale planting of shelter-belts will minimise soil erosion caused by wind. It will also help in the establishment of pastures and grazing lands. Later on, this land can be used for growing pearlmillet and mungbean.

Let us now discuss the other natural resources in this area. There is abundant sunlight in the desert areas and it can be harnessed for heating, cooking and lighting purposes. By doing so, the pressure to grow fuel-wood yielding trees can be considerably reduced. As said earlier, there are a large number of cattle found in this area. Animal dung is mostly burnt as a fuel, but its better use would be to mix it with the soil, so that the soil is enriched. Therefore, we need to deviate from the traditional use of these resources. This would benefit our arid lands and the people residing there, and the country in the long run. In the desert regions, solar energy can be utilised in yet another way. Here, the water is generally saline. The installation of solar stills can help us in the supply of clean drinking water, which would be a boon to the people of the area.

In years, when rainfall is good in arid areas as we have seen in 1988, a concerted effort should be made to seed the land with grasses, shrubs and trees that establish quickly when the soil is moist. We have Famine Codes that tell us how to minimise the suffering of people and livestock when rains fail. It is time we prepared a Good Weather Code also, so that people know what to do when the rainfall is good.

20.2.2 Drylands

Drylands are important to us, as they produce about 42% of our food. They supply us millets and pulses, as well as cotton and groundnut, on which a large proportion of our industry is dependent.

Drylands constitute about 74% of our cultivated lands. These are entirely rain-dependent. On these lands, crop fortunes are closely linked to the vagaries of the monsoon. Rains may set in very early or very late, or may come on time but withdraw too soon. There may also be large breaks between showers. When evaporation and loss of water by seeping in the soil exceeds rainfall, these lands are plagued by drought, scarcity of drinking water, crop failure and consequently unemployment and other human sufferings.

With the availability of good techniques of conserving water, and crops which grow quickly with little water, there is considerable scope for stabilising crop yields from drylands.

Since water is a limiting factor in drylands, as much run-off as possible should be collected in community-owned ponds, so that the crops can be given life-saving irrigation. In drylands

with red soil, deep ploughing helps in conserving water. In black soils, sowing two crops at a time is possible with surface drainage and good water management. Leaves and crop residues, when mixed with soil improve its texture, and water holding capacity. If crops like pigeonpea and castor that have deep roots, are cultivated in these regions, the physical condition of the soil improves further, as the roots of these crops add organic matter.

Now that varieties of sorghum, millets, sunflower, safflower, mustard, groundnut, various pulses and cotton are available which grow within a shorter time and can withstand scarcity of water, it is possible to diversify what grows in the drylands. A variety of crops and cropping patterns allow the farmer to make a proper choice of what to grow in different climates and soil types.

20.2.3 Hills

In the hilly regions of our country , tribals practise an age-old method of cultivation known as jhum or slash-and-burn or podu cultivation. Under this system, a patch of land on the hills is cleared of vegetation, and the plants are burnt. This ash eventually mixes with soil, which can support a crop of millet. This gives a modest yield to meet the immediate needs of the tribal farmer. When the crop is harvested, the land is abandoned and the tribals shift to adjoining areas, where the process is repeated. In about five years, the first piece of land put under slash-and-burn cultivation, by and large, recovers its natural fertility and supports shrub vegetation. The tribals come back to this land and start their primitive method once again. All this sounds very good, but actually it is not so. This system worked well, in the days when the population was small and shrub jungles were plentiful. Today, the tribals do not have much land to shift to, with the result that they cultivate the same piece of land again and again. Since practically no manure is applied, and the soils are given no time to recoup their nutrient losses in the natural way, their yields decline year after year. Soil erosion further aggravates the problem.

You might be wondering whether there is a solution to the agricultural problem of our hilly regions. Yes, there is. Based on a study of the slope and depth of the soil, and availability of water, scientists have devised an interesting agricultural system (see Fig. 20.1) which requires low inputs, and puts the land to a most productive use, without disturbing the ecosystem.

Fig. 20.1: Model land use, alternative to slash-and-burn (jhum) cultivation, in Meghalaya .

Under this system, the upper reaches of the hills are devoted to forestry. The next zone is developed for growing fruit trees, perennial fodder grass and legumes. The roots of legumes fix nitrogen and improve the soil. In the third zone, a mix of crops are raised on terraces constructed with low-cost implements. Earthen dams are constructed with locally available material. These collect enough water to be utilised for irrigation and fish culture. Poultry, piggery, bee-keeping, mushroom cultivation and related activities create a self-sustaining, complete farming system that perfectly blends with the ecosystem.

So far, you have studied how the advancements in our knowledge have enabled us to practice agriculture in difficult areas. Now, we shall take up a rather specific problem, that is of degraded soils. The saline and alkaline soils pose a lot of problems to our farmers. Let us now see how these are being dealt with.

20.3 RECLAMATION OF SALINE, ALKALINE SOILS

Saline and alkaline soils are the result of centuries of neglect and mismanagement of our soils. About 7 million hectares of land is thus affected. These unproductive soils cover about 2.5 million hectares in arid Rajasthan and Gujarat, 1.4 million hectares in the black-soil region, and 2.1 million hectares in the coastal regions. Alkaline soils contain high amounts of carbonates and bicarbonates of sodium. Saline soils contain chlorides and sulphates of sodium, calcium and magnesium. In both the above types of soils, salts are present in quantities large enough to interfere with crop growth.

As a result of research conducted since 1968, it is now possible to reclaim alkaline soils with the cultivation of fodder grasses like *Brachiaria mutica* (Para ghas), *Panicum antidotale* (Neelon ghas) and *Cynodon dactylon* (Doob), and tree species like *Prosopis chilensis (Vilayati khejri), Acacia nilotica* (Kikar) and hybrid *Eucalyptus*. The trees establish quickly if they are planted in small holes filled with manure to which a little gypsum is added. In the very first year after reclamation with grasses, this soil can be used for planting other crops. Here, special varieties of rice can be grown as kharif, and wheat as rabi crop. These crops have been found to give excellent results.

The crucial factor in the management of saline soils is drainage. Saline soils have a high water-table. Drainage channels one metre deep and 30 metres apart effectively bring down the water table and help in reducing soil salinity. Drainage costs are no doubt high, but we should not forget our lessons from history. Increasing salinisation caused by improper drainage forced Mesopotamia to completely abandon wheat cultivation, and saline soils played an important part in the break-up of Sumerian civilisation.

In the soils reclaimed in the above manner, sorghum, maize and wheat which can tolerate salinity of soil can profitably be raised. Though earlier, that is, before reclamation, such soils would not have supported any plant growth.

SAQ 1

Fill in the blank spaces choosing appropriate word or words from the list given below:

i) The areas that were considered difficult for agriculture were so because of non-availability of right kind of ..... and .....

ii) For the cold deserts, the ..... and ..... varieties are the most appropriate for cultivation.

iii) Fuel-wood yielding trees like..... , ... and ..... can be profitably grown in the arid zones.

iv) ..... is the limiting factor in drylands, and this difficulty can be overcome by suitable..... techniques.

v) Crops like ..... and ..... when grown in the drylands can considerably improve the condition of soil.

vi) The ..... method of cultivation is one of the important causes for the deterioration of the quality of ..... in the hilly regions.

vii) Alkalinity of soils is mainly due to the presence of high amounts of ..... and ..... of sodium.

viii) Saline soils consist of ..... and ..... of sodium, calcium and magnesium in excessive amounts.

ix) ..... is one of the important factors in the management of saline soils.

x) Now it is possible to reclaim alkaline soils by the cultivation of ..... and several ..... species, the latter are planted in small holes filled with manure and .....

(castor, cold resistant, bicarbonates, fodder grasses, temperature, safeda, pigeonpea, tree, chlorides, drainage, early maturing, gypsum, sulphates, carbonates, water management, moisture, kikar, slash-and-burn, mosquite, soil, water)

20.4 PROBLEMS ASSOCIATED WITH MODERN AGRICULTURE

Modern agriculture aims at producing the maximum amount of food in the minimum amount of time, space and energy so that our increasing population may have ample food and other agricultural products.

A study conducted in the mid-1950s showed that Asian and African farmers required 2.5 to 10 working days to produce one quintal (=100 kg) of grain. The time required to produce the same amount of grain was 3 hours in parts of France, and just 6 -12 minutes in parts of the USA. This fact is responsible for the difference in earnings, purchasing-power and life styles which exists between the developing and the developed countries.

On the other hand, the US farmer spends 65,000 kilocalories of energy to produce 1 kg of beef protein, and 2,860 kilocalories to produce 1 kg of wheat protein. He mostly uses chemicals derived from natural oil resources, and machines which again run on petrol, kerosene or diesel. All these are non-renewable natural resources. In contrast, the Asian farmer spends only 286 kilocalories of energy to produce 1 kg of rice protein. He mostly uses renewable, agro-based and organic substances for energy, in addition to human and animal energy. His technology is energy-thrifty, but it is labour intensive and time consuming.

Some observers believe that the agricultural production of the industrialised nations relies so heavily on non-renewable resources, that there is a clear danger of the oil and coal resources of the earth running out, bringing mankind to ruin. If we modernised agriculture to the same level as in the west, we could produce all we need, with perhaps a tenth of the manpower engaged in agriculture. The question is, what would the rest do? Would they be unemployed, if so, how will they buy what agriculture would produce? Yes, low energy input agriculture of the developing countries keeps nations precariously at the subsistence level, with development retarded, and malnutrition rampant, but moving to the other extreme of copying the industrialised countries could also be disastrous. The best course is probably the middle path. We should use modern science and modern ideas to minimise the use of non-renewable materials and energy, to use better seeds and cropping practices, and to reduce wastes of all kinds, be it land, water or even leaves and stems of plants.

Some enthusiasts contend that we should curtail the use of chemical fertilisers. But actually in our country the consumption of chemical fertilisers is one of the lowest in the world, a fraction of what it is in Japan or Europe. Field experiments have shown that chemical fertilisers are superior to bulky organic manures, in some ways but they are energy intensive and have to be used with due caution. Excessive use of fertilisers leads to a good deal of it being washed away by irrigation or rain water, which then pollutes rivers and ponds. A judicious combination of chemical fertilisers and organic manures is being recommended by our scientists. The challenge before our scientists is to retain the strength of traditional agriculture while meeting the needs of changing times.

About 87,000 tonnes of atmosphere is above each hectare, and about 70% of it is nitrogen that plants need. We must tap this abundant source by growing on a more extensive scale plants such as the various pulses, beans and peas. You already know the significant role played by such plants in fixing atmospheric nitrogen, and thus increasing the fertility of the soil.

As in the case of fertilisers, the average consumption of pesticides in our country is so small that there does not exist a situation similar to that prevailing in developed countries. The high-yielding varieties recently introduced put up such a luxuriant growth that pests are attracted to them much as we are attracted to tasty food. Plant-protection chemicals are safe when used strictly according to scientific recommendations. Indiscriminate and excessive use may, however, leave harmful residues, which may again pollute the environment particularly our water resources. Research on biological control of pests is urgently needed.

There has been a lot of discussion in the country about recent agricultural developments which have led to large tracts of land to be planted with high yielding varieties of wheat and rice, most of which need fertilisers and a well-defined routine of watering. Rich, large fields

of the same crop attract more pests, and therefore pesticides are necessary. Fertilisers and pesticides require, not only energy to produce them but also technology which has a large import component and hence needs foreign exchange. The result is that we have a Green Revolution and much greater agricultural production, but at the same time, greater dependence on other countries.

The other dilemma is that such agriculture, with chemical inputs and strict regimes for watering and protection of crops, can be managed much better by farmers with large fields. Much of the land in our country belongs to small holders who cannot benefit from the recent developments in equal measure. Hence this agriculture has, amongst other things previously mentioned, led to the rich in rural areas becoming richer, and poor becoming relatively poorer.

There is also a view that there was no alternative to increasing of total agricultural production. And that the modern technology is neutral to the scale of farming, provided proper practices are adopted by the small farmers too. This seems to be a rather difficult thing in practice, with the prevailing poverty and ignorance amongst the poor.

In a vast country like ours, a 10% decrease in production creates a scare of starvation deaths, and a similar increase in output brings in its wake problems of storage, grain-rotting, glut in the market and distress sale by farmers. The problems are more acute in the production of perishable commodities like vegetables, fruits, eggs, fish, milk and their products. The only way to tackle this problem is by providing a minimum guarantee price to farmers based on cost of production and ensuring that there are adequate facilities for efficient transport, processing and packaging so that the product is available at the doorstep of the consumer. Once again if processing and packaging can be done with our own technology developed by our research institutions, it would be excellent. Furthermore, if some of the food stuffs processed by foreign (or shared) companies are exported, we would deprive our people of the much needed foodstuffs like dried vegetables, fruit pulps and juices, and fish protein etc. Prices, in the Indian market, of these items would also go up. Thus you see that science can provide a package of practices for increasing production, and for meeting the needs of our people. It can sustain a dynamic agricultural growth only if accompanied by a package of appropriate public policies.

20.5 MISMATCH BETWEEN MAN'S SCIENTIFIC ABILITY TO PRODUCE AND SOCIAL INCAPACITY TO UTILISE

We now have the scientific and technological know-how to produce what our country needs. But lot of our people are poor, as they do not have gainful employment. Thus food is not available to them at the prices they can afford. Unless our scientific and technological skill is suitably backed by a political and administrative will to implement the right kind of rural and urban development programmes, poverty and malnutrition will continue to threaten us.

About 55.5 million people (22.7%) in our country are agricultural labourers who have neither land to cultivate nor farm animals to keep. They are willing to work hard, and expect to be paid by the evening, since they lead a hand to mouth existence. A vigorous employment-generation drive alone can improve their lot. For a number of historical reasons, however, employment generation is equated in our country with distributing doles, and a job-seeker is treated as if he is a burden to the society when he is actually offering his services, however modest, for his own benefit and the benefit of the country. At every level from the policy-maker to the village-level worker, there is a need for an overhaul of our social structure and outlook. Creation of job opportunities should be treated as a priority item of national service. Employment can be generated through (i) developmental programmes of the Government and (ii) group action backed by bank finance and village cooperatives. Marketing, storage, transport, distribution, processing and customer service are beyond the capacity of individual villagers. These can only be ensured by village cooperatives, which, in turn, should be connected to the national marketing grid.

The Government can take up massive programmes dealing with irrigation, supply of drinking water and construction of permanent roads and well-planned houses in the

countryside. These permanent national assets will generate the much-needed employment and provide purchasing power to villagers.

With the help of banks and insurance agencies, village cooperatives should pay special attention to problems of national importance that can be solved only through coordinated group action.

The twin problems of rapidly decreasing forest resources and extensive soil erosion can be effectively checked by large-scale plantations on our cultivable wastelands and along roadside in villages. This is of utmost importance, since we are presently cutting off ten trees for every one tree planted. Our duty is not over by just planting trees, but we should take care of them till they reach a stage, when they can grow on their own.

Composite fish culture (also see Unit 19, Sub-section 19.9.2) and the cultivation of high-value vegetable and fruits are highly remunerative professions. But our farmers are wary of bulk production because they think that it would lead to a glut in village markets and result in lowering the prices. A national chain of village cooperatives that attend to marketing, storage and distribution network will benefit both the producer and the consumer.

The precariously low amounts of protein and fat in our diet is a matter of great concern. A well-organised marketing and processing network has a tremendous potential to increase the cultivation of the protein-rich soybean which will prove a boon to our malnourished people. Likewise, an all-out effort is needed to devote more attention to oilseed crops, including oilpalm. We are now importing a lot of edible oil. In rich nations, excessive intake of fat is discouraged as it would aggravate the problem of heart diseases. But in our country, inclusion of more fat in the diet, barring that of a few affluent people, is not only desirable, but is necessary because fats are not only a concentrated source of food calories but act as important vehicle for some vitamins.

The low per head availability of cloth is another alarming trend. Even in our best cotton tracts, the average yield of cotton is only about 370 kg per hectare compared with 700 kg per hectare in Egypt, where cotton cultivation is managed co-operatively without infringing on the rights of individual owners. In the management of pests of cotton, rice, groundnut, sugarcane and plantation crops, as well as the control of the contagious diseases of cattle, individual attention is futile and a community action of the entire village or block only, will prove effective. Efficiently run cooperatives with adequate facilities for health care of plants and animals is the immediate need of our villages. Conservation of runoff water in ponds, proper utilisation of groundwater resources, finding uses of agricultural wastes, use of solar, and wind energies and installation of bio-gas plants are areas in which village cooperatives can play an exemplary role, create an abundance of employment opportunities, and usher in an "antyodaya" of Mahatma Gandhi's dreams.

It would be a paradox if we produce enough food to eat but the majority of our people have not enough money to buy it with.

20.6 BIOTECHNOLOGY IN AGRICULTURE

Production of enough food to meet the demands of an ever-increasing population in the world is a major task and a challenge to agricultural scientists. The conventional agricultural methods can no longer cope with the situation. In recent years, biotechnology has emerged as an important discipline which may offer solutions to many problems presently being faced by agriculture. Before we proceed any further, let us first understand what we mean by biotechnology. It deals with the use of biological systems or their products in large-scale industrial processes.

Today, agricultural biotechnology has progressed to a stage that plants with several improved characters can be produced. The examples of these improved characters are high yields, resistance to diseases, improved nutritional quality, and adaptation to adverse environmental conditions. An important aspect in the production of improved plants, is the breeding process. This enables one to combine, one or more, favourable characters of the parents to be passed on to their progeny. For this purpose, scientists use several methods for raising the plants. The most common methods are: (i) the traditional method, in which seeds and root stocks have been used as basic materials for raising plants, (ii) the other method that makes use of the important quality of plant cells. that is, any plant cell can give rise to a

complete plant. Based on this fact, any cell or a group of cells, or part of a plant such as a piece of stem, leaf etc. can be grown on a nutrient medium under suitably controlled conditions in the laboratory. This method is commonly known as tissue culture. It, however, enables us to get true breeding types without going through the stages of flowering, production of seeds and their germination. This technique has a great potential in our crop improvement programmes, and it has already been used in the improvement of varieties of wheat, rice, corn and several other plants. This method is useful not only for the improvement of present-day crops, but also for the creation of novel plants and new crops, which are of short duration, high-yielding-type, and resistant to diseases and other adverse environmental conditions. One of the problems faced by the agricultural scientists engaged in crop improvement is that the embryos of many new crops developed abort, i.e., they do not survive in nature. Therefore, one is not able to obtain their adult plants. This difficulty, however, has been overcome by the application of tissue culture, whereby, these embryos are grown on a nutrient medium, under controlled conditions in the laboratory and later planted in the field.

In the recent years, another technique known as genetic engineering has held the attention of the agricultural scientists. It involves the alteration of genetic material of a particular plant, by the substitution or addition of new genetic material from some other plants. You are already familiar with the leguminous plants and their nitrogen fixing property. Presently, the scientists, are trying to transfer this genetic material, that enables legumes to fix nitrogen, to various economically important plants. If this is achieved, it would be a milestone in agriculture.

If we apply the principles of biotechnology and raise orchards, the fruit trees will be of desired, manageable height and form. The fruits will be of uniform size, shape, colour and weight. They will have the same flavour and nutritional value, and will ripen at the same time. This will make harvesting, storage, packing, transport, canning and processing easy.

So far, we have discussed some applications of biotechnology in plant improvement. Similarly, biotechnology, also offers a wide scope for the improvement of our animal breeds. The embryo-transfer technology offers great scope to produce pedigree animals on a mass scale within a short time. For this purpose, a cow of a good breed is induced to produce many eggs through hormonal treatment. After they are fertilised, the embryos are taken and planted in healthy cows, known as surrogate mothers. Ultimately we can get many calves of a superior breed in a short time.

The new vistas opened up by biotechnology have attracted the attention of big business houses, who have started pouring money into new projects. Some people even apprehend that multinational companies may soon monopolise 'factory farming' and mass-production of food articles at prices so cheap that the traditional farmers of developing countries may go out of competition and become bankrupt. However, with international cooperation, joint venture and adequate technology transfer, biotechnology will prove to be a boon to all futuristic global agricultural strategies.

SAQ 2

Fill in the blank spaces choosing appropriate word or words from the list provided.

i) One of the foremost problem associated with modern agriculture is that of ..... .

ii) It is believed that the agricultural technology used by developed nations is ..... intensive, whereas that of the developing nations is ..... intensive.

iii) The use of ..... has become an integral component of modern agriculture, and some of the problems arising due to their excessive usage can be considerably avoided by using them in combination with the organic ..... .

iv) Various ..... chemicals should be used strictly according to scientific recommendations, as many of them leave harmful ..... in the environment.

v) We can minimise many difficulties associated with modern agriculture by the use of ..... resources for energy, better ..... , ... practices and by reducing ..... of all kinds.

vi) In order to make best utilisation of the high production of perishable goods, we must have adequate facilities for efficient ..... , ... and ..... so that they are readily available to the consumer.

vii) There is not only a need to increase our agricultural ..... but also to overhaul our ..... structure and outlook.

viii) An individual villager is unable to organise the ....., ..., ..., ... and ..... of his produce. This however, can be ensured by certain village ..... which in turn should be connected to the national grid.

ix) For the plant improvement programmes, young plantlets can be raised from ....., ... or by the use of .... technique.

x) ..... technology, that involves the transplantation of ..... from a healthy mother to ..... mothers, is a faster way of producing several calves of the same type.

(social, renewable, surrogate, transport, marketing, production, seeds, chemical fertilisers, wastage, embryos, root stocks, seeds, embryo transfer, storage, processing, residues, manures, energy, labour, cropping, packaging, transport, tissue culture, distribution, cooperatives, plant protection, energy, processing)

20.7 SUMMARY

- Today we are able to profitably use the areas like the arid zones, drylands and hilly regions for agricultural purposes. This has been possible because of the use of varieties of crops and breeds of animals that are most suited for these regions. We can further make these areas more productive by slight changes in our traditional practices.
- A considerable portion of our agricultural lands are affected by the problem of alkalinity and salinity of soils. In such soils, salts are present in large enough quantities that they interfere with crop growth. Alkaline soils can be used as well as improved, by growing suitable trees, and grasses. Later, alkali-resistant varieties of rice or wheat can be grown. The key factor in the management of saline soils is drainage. If such lands are well-drained, saline-resistant varieties of sorghum, maize and wheat can be profitably grown.
- Modern agriculture aims at producing maximum amount of food with the minimum amount of time, space and energy. There are number of problems associated with the present day agriculture. The foremost is that of energy. There is considerable dependence on our non-renewable resources. These resources being finite, would soon get depleted. We should, however, achieve our targets of high production by application of modern science to minimise the use of non-renewable materials, using better seeds and cropping practices, and by the utilisation of chemical fertilisers and in combination with organic manures in judicious quantities. The other main problem is the production output. If it is less, there would be starvation deaths. Excessive output too has other set of problems. There is, a need to provide a minimum guarantee price to farmers based on cost of production. Also, adequate facilities for efficient transportation, processing, and packaging would help in making the products easily available to the consumers.
- Today we have the know-how and technology to produce what our country needs, but still a majority of people do not get food as they lack the purchasing power. A vigorous employment generation drive can help in improving the situation. Besides that, a chain of village cooperatives would attend to other problems of farmers such as marketing, storage and distribution.
- Biotechnology is fast emerging as an important discipline that offers new vistas in agriculture.

20.8 TERMINAL QUESTIONS

1) Comment briefly on agriculture in the following special areas:

i) arid zone

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ii) drylands

iii) hilly regions

2) Mention in points, the salient problems associated with modern agriculture.

3) 'There is a mismatch between man's scientific ability to produce and social incapacity to utilise'. Analyse the statement.

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4) In what ways can biotechnology play an important part in agriculture?

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20.9 ANSWERS

Self Assessment Questions

1) i) temperature, moisture
   ii) early maturing, cold resistant
   iii) kikar, mosquite, safeda
   iv) water, water management
   v) castor, pigeonpea
   vi) slash-and-burn, soil
   vii) carbonates, bicarbonates
   viii) chlorides, sulphates
   ix) drainage
   x) fodder grasses, tree, gypsum

2) i) energy
   ii) energy, labour
   iii) chemical fertilisers, manures
   iv) plant protection, residues
   v) renewable, seeds, cropping, wastage
   vi) transport, processing, packaging
   vii) production, social
   viii) marketing, storage, transport, distribution, processing, cooperatives

ix) seeds, root stocks, tissue culture

x) embryo transfer, embryos, surrogate

Terminal Questions

1) i) In the arid zones, where the temperatures are low and there is scarcity of water, those crops that mature faster and can withstand cold are grown. Also, hardy animals like goats, camels etc. are reared in these regions. In places where temperatures are high, suitable grasses and trees that yield fruits or fuel-wood are grown. Excellent breeds of cattle, sheep and goats can be reared in such regions.

ii) These areas are dependent on rains for their water supply. The recently developed techniques for conserving water, make such areas suitable for agriculture. Such varieties of crops that require less amount of water are grown here. Crops like sorghum, sunflower, safflower, mustard, groundnut, cotton and various pulses are well suited for such areas. Due to the addition of organic matter from the crops, the water holding capacity of such soils is increased.

iii) For a long time, in some parts of the hilly regions and even today, jhum cultivation has been the only way of cultivation. This practice, however, has caused considerable damage to the soil. Presently, a modern system of cultivation is being practised in many areas, and is proving very useful. Under this system, the upper reaches of hills are devoted to forestry. In the next zone fruit-trees, grasses and legumes are grown. In the third zone, a mix of crops are raised on terraces. Provision for storage of water is made. Fish culture, bee-keeping etc. make it a complete farming system.

2) i) Source of energy presently considerable pressure is on non-renewable resources, that are feared to run out in the near future.

ii) Too much mechanisation would no doubt increase production, but would also result in unemployment and poverty, hence people would lack purchasing power to buy food.

iii) Much of the technologies and methods used are quite wasteful. Some wastes such as chemical fertilisers and pesticides build up in the environment causing long term harmful effects.

iv) Many of the modern technologies can be applied to large fields. But most of our farmers are small land holders and they cannot benefit from these recent developments.

v) In developing countries like ours even a 10% increase in production poses problem of storage, glut in the market and distress sale. The problem becomes acute, if these are perishable commodities.

3) i) Though we have the scientific and technological know-how to produce what country needs, but most of our people are poor and cannot make use of it. A large number of people do not have enough money to buy even food.

ii) About 22.7% of our people are agricultural labourers and have no land, and they have hand to mouth existence.

iii) Facilities for marketing, storage, transport, distribution, processing and customer service are beyond the capacity of individual farmers more particularly the ones with small land holdings.

4) Biotechnology can help tremendously in the production of improved varieties of plants and animals. New techniques such as tissue culture, not only enable us to grow novel plants, but also enables one to mass-produce plants in a shorter time without going through the steps of flowering, production of seeds, and their germination. By the application of principles of genetic engineering, plants can be produced with desired qualities. If we apply biotechnology to raise orchards, the fruits produced will be of uniform size, shape, weight etc. This makes their harvesting, storage, packing, transport, canning and processing easier. The embryo transfer technology would enable us to produce many copies of a good animal breeds faster.