UNIT 11 DRYLAND FARMING AND AGRO-CLIMATIC ZONING

Structure

11.0 OBJECTIVES

After going through this Unit, you will be in a position to:

- explain the importance and features of dryland farming;
- summarise the policies, incentives, programmes and projects of government and non-government agencies towards dryland farming;
- explain the significance of ago-climatic zoning;
- identify various agro-climatic zones in India as categorized by different agencies; and
- appreciate the applicability of biotechnology in the field of dryland agriculture.

11.1 INTRODUCTION

We learnt from the previous Unit that irrigation potential of India is limited and all cultivable land cannot be irrigated. Thus a large part of the cultivated area has to depend upon natural rainfall. Therefore, we have to look into the prospects of rain-fed farming. Given the fact many parts of the country receive scanty rainfall we have to develop appropriate technology for these regions.

The importance of dryland farming can be appreciated from the following:

- In India rain-fed area accounts for 74% of the total cultivated area and contributes substantially to agricultural production. Out of the total 144 mha cultivated area, only 37 mha (26%) are irrigated and rest are rain-fed.
- Dryland area contributes about 44% of total foodgrain production and about 75% of pulses and oil seeds.
- A large number of industrially important crops such as cotton, and groundnut are cultivated under dryland condition.

11.2 CONCEPT OF DRYLAND FARMING

Dryland farming is the practice of crop production entirely with rainwater received during the crop session. In low rainfall areas of arid and semi-arid climates the crop may face mild to very severe moisture stress during its life cycle. A dryland crop refers to a crop grown on well-drained soil where the ground water remains far below the soil layers occupied by the crop root throughout the year. The water requirements of the crop are thus satisfied solely by natural rainfall, i.e., surface soil moisture from precipitation is the primary source of moisture for the crop.

11.2.1 Nature of Rainfall in India

There is wide variation in the amount of rainfall received in different parts of India. It is as low as 10 cm in western Rajasthan and up to 1000 cm in Meghalaya. India receives an average annual precipitation of 400 million hectare metres (mhm), of which 70 mhm is lost through evaporation. Of the remaining 330 mhm, around 150 mhm is absorbed by the soil while 180 mhm constitutes the run-off. Of the 180 mhm run-off, we have been able to utilise only 20 mhm through contruction of reservoirs and watersheds. Thus about 160 mhm of water is left as run-off to the sea through the rivers.

Nearly 80% of the total rainfall is received during the period July–September (about 90 days) in India. The amount of rainfall and its distribution during the rainy season determines the yield and production of crops. Factors such as: i) late onset of monsoon, ii) long dry spells during the season, and iii) early withdrawal of monsoon adversely affect production.

The amount of rainfall, its distribution, and water retention capacity of soil determines the ‘crop growing period’ in rain-fed areas. You will be surprised to know that growing period varies from 30 days to 300 days in India. Thus we have to select crops and cropping pattern keeping in view rainfall and soil quality in view.

Depending on the amount of rainfall received, farming in rain-fed areas can be of four types: i) Arid areas where rainfall is less than 50 cm per annum, ii) semi-arid areas with an annual precipitation of 50-75 cm, iii) sub-humid areas where precipitation is between 75-150 cm, and iv) humid areas with an annual rainfall of above 150 cm. In the arid and semi-arid areas there are prolonged dry spells during the crop growing period. Crop failures are more frequent in the arid and semi-arid areas. In the sub-humid areas there are dry spells during crop period, but the probability of crop failure is comparatively less. In the humid areas the probability of crop failure is rare but drainage of rain water is a major problem.

Apart from rainfall, two important factors responsible for increasing yield in rain-fed areas are: i) soil quality, and iii) availability of appropriate crop variety. In order to increase yield and production in rain-fed areas efforts have been made in two directions: i) the cultivable area of the country has been categorised into several homogeneous agro-climatic zones, and ii) research and development (R&D) efforts have been made to develop crop varieties and cropping pattern suitable for different agro-climatic regions. In this respect application of bio-technology in agriculture has played an important role. We will discuss about these two aspects later in this Unit.

11.2.2 Need for Dryland Farming

Dryland farming is the only way to utilize a vast geographical area with abundant sunshine and moderate fertility of soil. The productive capacity of these areas has not been exploited properly thereby keeping these areas as economically backward. As a result, economic and social inequalities among the farming community have gove up across regions.

The philosophy of dryland farming revolves around the principle that water is a limiting factor and one needs to maximize the efficiency of natural rainwater for crop production. The need for scientific approach towards farming in rain-fed areas is felt with the realization that the occurrence of drought is more or less inevitable. In rain-fed areas, emphasis has to be given on matching the crop to the soil and water availability and not vice-versa as it is with irrigated farming. Dryland farming has two dimensions:

- Growing and managing crops that can be profitable under the rainfall deficient years, during which drought tolerance and efficient water use are the main requirements.
- Growing and managing crops that are capable of making the best and efficient use of favourable environmental conditions provided during the good rainfall years.

Because of the uncertain nature of water availability in rain-fed areas, the risk of crop loss is higher. Such risks can be minimized by adoption of short-duration HYV and water-efficient crops. Moderate application of fertilizer containing nitrogen and phosphorus improves water efficiency. It is found that fertilizer helps the crops in withstanding the adverse effects of drought. It also recovers faster from drought when relieved from stress. You might be aware that weeds compete with crops for moisture and nutrients. Therefore, a weed free field for the first 30 to 40 days is crucial as they can cause a loss of 50 per cent to crop yield.

11.3 POLICIES AND INCENTIVES FOR DRYLAND FARMING

India experienced a rapid expansion in agricultural research system during the 1960s. During this period, however, the major concern was to increase agricultural production. Thus emphasis was given on development of crops suitable for the more fertile and irrigated areas. The development strategy of this decade is reflected in the Green Revolution that took place.

However, during the 1970s there was an emphasis on development of rain-fed areas. All-India Coordinated Research Project for Dryland Agriculture (AICRPDA) was initiated in 1970 at 23 centres representing different agro-climatic regions. Presently India has one of the strongest agricultural research system in the world. There is a network of 49 research institutes, 30 national research centres, 29 agricultural universities, 10 Project Directorates and a large number of All-India Coordinated Projects involving more than 24000 agricultural scientists and teachers.

Efforts on development of dryland farming have put emphasis on: i) rain-water and soil management, and ii) crop production technology. In order to increase production in rain-fed areas the government has taken several measures to harvest rainwater. Several schemes and projects on watershed development are going on in the country.

11.3.1 Rain-water Management

The planners have started realizing that it is quite difficult to obtain any incremental production from the conventional Green Revolution areas. For the second Green Revolution it is necessary to make the gray areas green. Hence emphasis has shifted to rain-fed areas, especially in the Eastern and arid peninsular India. Six programmes and projects have been launched for utilization of the potential of dryland areas. The objectives are:

i) Realisation of the projected requirement of about 240 m tons of annual food grain production and smoothen out annual fluctuations of food grain yield.

ii) Reduction in regional disparities between irrigated and vast rain-fed areas.

iii) Restoration of ecological balances by greening rain-fed areas through appropriate mixture of trees, shrubs and grasses, and

iv) Generation of employment for rural masses and reduction in large-scale migration from rural areas to already congested cities and towns.

These projects are as follows:

A) **National Watershed Development Project for Rain-fed Areas (NWDPRA)**

The National Watershed Development Project for Rain-fed Areas (NWDPRA) was launched in 1990-91. It covers 25 states and two union territories. The project started with the objectives of restoring ecological balance in rain-fed areas and sustainable biomass production. It focuses on:

a) Conservation, up-gradation and utilization of natural endowments in an integrated manner with low cost replicable technology.

b) Generating employment opportunities for the poverty stricken rural masses in the Rain-fed areas through directly involving the farmers and watershed beneficiaries in the planning and execution of all project works in the watershed by developing self-help groups.

Under this project the target was set for treating an area of 28 lakh hectares at a cost of Rs. 1100 crore.

B) **World Bank Assisted Watershed Development Projects**

The integrated watershed development projects (IWDP) has been in operation since 1991-92.The main objective of the project was to slowdown and reverse degradation of natural environment through the use of appropriate utilization of soil and moisture conservation technology and improved production methods.

C) **Agricultural Development Project**

The Agricultural Development Project (ADP) with the assistance from the World Bank is being implemented in various states to enhance sustainability in agricultural development and dryland agriculture.

D) **DANIDA Aided Projects under Dryland Farming**

The Government of Denmark launched integrated watershed development project in the state of Karnataka in 1990-91. Later on it was spread to various states. The second phase of this project has been negotiated and project became operational from 1995.

E) **European Economic Community Assisted Project**

European Economic Community assisted integrated watershed management project has been in operation since 1989.

F) **Swiss Development Corporation Assisted Project**

The project aims to develop 5 watersheds in five districts of Karnataka through the on-going participatory integrated watershed development project (PIDOW). It is in the process of extension to other states.

11.3.2 Crop Production Technology

Efforts in the direction of crop production technology have concentrated on development of high-yielding and appropriate varieties of crops and implements. Varieties of short-

duration crops in sorghum, millet, cotton, pulses, etc. have been developed to match the short growing season of rain-fed areas. In spite of the fact that these crops yield less fodder, these are readily accepted by the farmers, because of higher yield and response to fertiliser application and crop management.

The drills plough, which is simple and suits animal power is affordable by small and marginal farmer and it accelerates seeding. It requires one-third labour and covers two times more area compared to traditional seeding. It can be manufactured with locally available materials at a cost of around Rs.400.

In addition to development of crop varieties, research on appropriate cropping system is also going on. Research on resource use optimization has led to the development of a number of alternative land use options which bring about stability by distributing risk among crops. These include tree or pasture based cropping in harmony with agriculture on catchment basis. Agro-forestry, horticulture, etc. are typical examples of alternative land use system. Multi-value crops that generate food, ensure uninterrupted supply of fuel and fodder, and are environment friendly have been identified. Besides stabilizing productivity, alternative land use systems also moderate the impact of drought.

Check Your Progress 1

1) What is the need for dryland farming?

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2) What are the different types of rain-fed areas?

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3) What are the important projects undertaken for development of rain-fed areas.

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11.4 NEED FOR AGRO-CLIMATIC ZONING

An agro-climatic zone refers to areas having similar climatic conditions. The extent of rainfall, soil quality, moisture level, etc. make it suitable for a certain range of crops.

The purpose of climatic classification is to: i) study the climate systematically, and ii) understand its general patterns and ecological conditions. It also helps in making reliable estimates of agricultural potential, and deciding issues related to technology

transfer suitable to each of the climate zones. As it is not possible to replicate every experiment on every farm in each agro-climatic zone, a representative site is chosen and results are extrapolated to other sites of similar conditions.

The identification of agro-climatic zones helps us in devising land and water development strategies so that balanced agricultural development is achieved. It also helps in development of location specific research and development strategies. As a result, appropriate crop varieties and cropping patterns for each region are identified. It helps in planning for non-crop based agricultural activities like forestry, animal husbandry and fisheries and in identification of appropriate development projects and financial resources for each region.

You will see later in Unit 13 that Green Revolution resulted in wide regional imbalances in agricultural development during the 1960s and 1970s. Rain-fed areas remained untouched by Green Revolution which necessitated agricultural planning based on agro-climatic zones.

From macro-planning perspectives the main objectives of agro-climatic zoning are: (i) realization of a broad demand-supply balance in major commodities at the national level, based on potential and prospects of various zones, (ii) increase the net income of farmers, (iii) generation of additional employment, particularly for the landless labourers, and (iv) development of a framework for the scientific and sustainable use of natural resources particularly land, water and forests, in the long run.

Thus the important aspects of planning in agro-climatic Zones are:

a) *Crop planning:* Diversification and introduction of high value crops, evaluating their suitability on particular land mass.

b) *Irrigation plan:* Development of irrigation plans based on the agricultural and climatic condition.

c) *Research and Development:* Development of location specific high yielding strains of crops and livestock keeping in view the suitability of climatic condition and land mass position.

The Ninth Plan strategy for agriculture is based on a 25 year Perspective Plan for the Development of Rain-fed Areas. Emphasis is being laid on a regionally differentiated strategy. Broadly at the macro level these regions are grouped into four Agro-Economic regions:

a) High productivity zone, having either high level of irrigation or low rainfall with low irrigation situations. Usually these areas have a low incidence of poverty.

b) Low productivity zone, having relatively high rainfall, low to medium irrigation and high productivity potentials, but high level of poverty at present;

c) Low Productivity zone, having low rainfall, low irrigation, low level ground water, and high incidence of poverty

d) Agro-ecologically fragile zone, having low productivity, high run-off, and soil erosion. The areas include North Western Himalayas, North-East, deserts of Rajasthan, and drought-prone Gujarat.

11.5 AGRO-CLIMATIC ZONES IN INDIA

Several attempts have been made to delineate major agro-ecological regions with respect to soil quality, climatic condition and natural vegetation. Various agencies have attempted classification of agro-ecological regions. Some of these agencies are:

i) Agro-ecological regions by the Indian Council of Agricultural Research (ICAR)

ii) Agro-climatic regions by the Planning Commission

iii) Agro-ecological regions by the National Bureau of Soil Survey and Land-use Planning (NBSS & LUP)

We discuss these zones below.

11.5.1 Agro-ecological Regions by ICAR

The ICAR has classified India into eight agro-ecological regions. These are as follows:

i) Humid Western Himalayan Region: It consists of Jammu and Kashmir, Himachal Pradesh and Uttaranchal. It is characterised by high mountains and low valleys. The climate varies from hot to sub-humid tropics in the south to temperate- cold-arid in the north with rainfall ranging from 80 cm to 100 cm.

ii) Humid Bengal Assam-Basin: It consists of West Bengal and Assam representing Ganga-Brahmaputra alluvial plain. It is characterized by semi-stabilized sand dunes on alluvial terraces, latrite remnants in the west and numerous creeks and swamps in the deltaic tract. The rainfall ranges from 220cm to 400 cm.

iii) Humid Eastern Himalayan Region and Bay Islands: It consists of Arunachal Pradesh, Nagaland, Manipur, Mizoram, Tripura, Meghalaya and Andaman Nicobar island. It includes the eastern Himalayan and Arakan ranges with a wide range of elevation.The rainfall ranges from 200 cm to 400 cm.

iv) Sub-humid Sutlej–Ganga Alluvial Plains: It comprises Punjab, plains of Uttar Pradesh, Delhi and Bihar. The rainfall ranges from 30cm to 200 cm. The soils are highly disturbed in Bihar due to frequent floods.

v) Subhumid to humid eastern and south-eastern uplands: It comprises Orissa, Andhra Pradesh and Chhatishgarh. It is characterized by undulating topography, denuded hills, plateau, river valley and highlands. The rainfall ranges from 100cm to 180 cm.

Table 11.1 : Rainfall and Soil Types by ICAR

Agro-climatic Region	Average annual rainfall (in cm)	Soil Type
Humid Western Himalayan Region	80-100 cm	Sandy loam, loamy and acetic sub manture, loamy brown hillsoil
Humid Bengal Assam basin	220-400 cm	Alluvial, red and brown soil
Humid Eastern Himalayan Region and Bay Islands	200-400 cm	Red yellow alluvial and acidic latrite
Sub-humid Sutlej Ganga alluvial plain	30-200 cm	Alluvial, saline and alkali soil
Sub-humid to humid eastern and south eastern uplands	100-180 cm	Mixed black, red, yellow, red sandy, latrite, black alluvial soil
Arid Western plains	10-65 cm	Alluvial, black, latrite, mixed red and black soil
Semi -arid lava plateau and central highlands	330-750 cm	Alluvial, black latrite, mixed red and black soil
Humid to semi arid Western Ghats and Karnataka plateau	60-300 cm	Black, red, latrite and alluvial soil

vi) Arid Western Plain: It includes Haryana, Rajsthan, Gujarat and Dadra Nagar Havellis. It is characterized by alluvial plain with sand dunes, saline depressions and granite hills. The rainfall in this region ranges from 10cm to 65cm.

vii) Semi-arid lava plateau and central highlands: It comprises Maharastra, Goa, Daman Diu and Madhya Pradesh. The rainfall ranges from 70 cm to 125 cm except in the Western Ghats where it varies from 330 to 750 cm. Major soil groups are alluvial, black, latrite, mixed red and black , and yellow brown.

viii) Humid to semi-arid western ghat and Karnataka plateau: It consists of Karnataka, Tamil Nadu, Kerala, Pondicherry and Lakshadeep islands. The rainfall ranges from 60 to 300 cm. Major soil groups are black, red, letritic and alluvial.

11.5.2 Agro-climatic Regions by Planning Commission

The Planning Commission under the Seventh Plan divides India into 15 agro-climatic zones based on soil quality, geological formation, climate, cropping pattern and development of irrigation and mineral resources. These are:

1) Western Himalayan Region
2) Eastern Himalayan Region
3) Lower Gangetic Plains Region
4) Middle Gangetic Plains Region
5) Upper Gangetic Plains Regions
6) Trans Gangetic Plains Region
7) Eastern Plateau and Hill Region
8) Central Plateau and Hill Region
9) Western Plateau and Hill Region
10) Southern Plateau and Hill Region
11) East Coast Plateau and Hill Region
12) East Coast Plains and Ghat Regions
13) Gujarat Plains and Hill Regions
14) Western Dry Region
15) The Island Region

11.5.3 Agro-ecological Regions by NBSS and LUP

The NBSS and LUP has brought out agro-ecologoical regional maps of India consisting of 21 zones based on physiography, soil and bio-climatic conditions. These zones are grouped under six ecosystems. These are as follows:

a) **Arid Ecosystem**

1) Western Himalayas, cold arid eco-regions with shallow skeletal soils.
2) Western plains, hot arid eco-regions with deserts and saline soils.
3) Deccan plateau, hot arid eco-regions with mixed red and black soils.

b) **Semi-Arid Ecosystem**

4) Northern plains and central highlands, hot semi-arid eco-region with alluvium derived soils.
5) Central highlands and peninsula, hot semi-arid eco-region with medium and deep black soils.

6) Deccan plateau, hot semi-arid eco-region with shallow and medium black soils.
7) Deccan plateau and eastern ghats, hot semi-arid region with red and black soils.
8) Eastern ghats and Deccan plateau, hot semi-arid eco-region with red loamy soil.

c) **Sub-Humid Ecosystem**

9) Northern Plains, hot sub- humid eco-region with alluvium derived soils.
10) Central highlands, hot sub- humid regions with medium and deep black soils.
11) Deccan plateau and central highlands, hot sub-humid eco-regions with red and black soils.
12) Eastern plateau, hot sub- humid eco-regions with red and yellow soils
13) Eastern plateau and Eastern Ghats, hot sub- humid eco region with red loamy soils.
14) Eastern plains, hot sub-humid with alluvium derived soils.
15) Western Himalayas, warm sub-humid eco-region with brown forest and podzolic soils.

d) **Humid–Per Humid Ecosystem**

16) Assam and Bengal plains, hot humid eco-region with alluvium derived soils.
17) Eastern Himalayas, warm per- humid eco-region with brown hill soils.
18) Northeastern hills warm per- humid eco-region with red and latertic soils.

e) **Coastal Ecosystem**

19) Eastern coastal plains, hot sub-humid eco-region with alluvium derived soils.
20) Western Ghats and coastal plains, hot humid – per-humid eco-regions with red, lateritic and alluvium derived soils.

f) **Island Ecosystem**

21) Islands of Andaman Nicobar and Lakshadweep, hot per humid with red loamy and sandy soils.

Table 11.2 : Rainfall and Soil Types by NBSS & LUP

Sl. No.	Agro-climatic Regions	Average annual rainfall (in cm)	Area in%	Annual growing periods (in days)
1)	Western Himalayas, Cold arid ecosystem with shallow skeletal soils	15	47	90
2)	Western Plain, Hot Arid, Ecosystem with Desert and saline soils	30	9	90
3)	Deccan Plateau, hot arid eco-region with mixed Red and Black soil	40-50	14	90
4)	Northern Plain and Central Highlands, Hot semi-arid Ecoregion with alluvium derived soil	40-80	10	90-150
5)	Central (Malwa) Highlands and Kathiawar peninsula, Hot semi-arid eco-region with medium and deep black soil.	60-90	5.6	90-150
6)	Deccan plateau, Hot semi-arid eco-region with shallow and medium (including deep) black soils	60-100	10	90-150
7)	Deccan plateau and Eastern Ghats, Hot semi-arid eco-region with red and black soil	60-100	6.3	90-150
8)	Eastern Ghats (TN) Uplands and Deccan plateau, Hot semi-arid eco-region with red loamy soils	60-100	6.9	120-150
9)	Northern Plain, Hot sub-humid eco-region with Alluvium derived soils	100-120	3.7	150-180

10)	Central Highlands (Malwa and Bundelkhand), Hot sub-humid eco-region with medium and deep black soil	100-150	4.2	150-180
11)	Deccan Plateau and Central Highlands (BundelKhand), Hot sub humid eco-region with red and black soil	100-150	4.2	150-180
12)	Eastern Plateau (Chhatishgarh region), Hot sub-humid Eco-region with red and yellow soils	120-160	4	150-180
13)	Eastern (Chhotanagpur) plateau and Eastern Ghats, Hot sub-humid eco-region with red loamy soils	100-160	8.5	150-180
14)	Eastern plain, Hot sub-humid with alluvium derived soils	140-160	2.8	180-210
15)	Western Himalayas, warm sub-humid (including humid) eco-region with Brown forest and Podozolic soils	160-220	5.4	150-210
16)	Assam and Bengal plains, Hot humid (including sub-humid) eco-region with alluvium derived soils	140-200	3.6	270
17)	Eastern Himalayas, Warm per-humid eco-region with brown hill soils	200	2.4	270
18)	North eastern Hills (Purva natal) Warm per humid eco-region with red and latritic soils	160-260	3.3	270
19)	Eastern Coastal plain, hot sub-humid eco-region with alluvium derived soils	120-160	2.5	150-210
20)	Western Ghats and Coastal plains, Hot humid per-humid eco-region with red, latritic and alluvium derived soils	200	3	270
21)	Islands of Andaman Nicobar and Lakshadweep Hot per-humid eco-region with red loamy and sandy soils	160-300	0.3	270

Check Your Progress 2

1) What is the purpose of agro-climatic zoning?

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2) Which are the four major agro-economic regions in India ?

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3) What are the basic features of humid Bengal-Assam basin?

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11.6 BIOTECHNOLOGY FOR AGRICULTURE

Biotechnology refers to the use of living organisms for the manufacture of useful products. Micro-organisms such as useful traits of algae, bacteria, fungi, yeast, and cells of higher plants and animals can be combined to manufacture new varieties of crops. Thus the hybrid varieties of crops that we see today are the product of biotechnology.

The term "biotechnology" is derived by combining the words 'biology' and 'technology'. It concerns with the exploitation of biological organisms for generating products/ services that are useful to man. There are two important features of biotechnology:

- utilization of biological entities, their components or constituents, and
- generation of some product or services for enhancement of human welfare.

Biotechnology has affected many major areas of human activity and welfare such as industries, medicine, agriculture and environment. It has been used as an important force for creation of quality product, enriching human consumption and propagation of quality animal and plant life. It has also created ample scope for employment, trade and influenced national economy.

Contribution of biotechnology to agricultural development is represented by achievements in rapid clonal multiplication of plants of economic importance, production of virus-free plants, rescue of otherwise nonviable interspecific hybrid, production of hybrids from sexually incompatible combinations through hybridization, etc. Efforts are being made to improve photosynthetic efficiency, nitrogen fixation efficiency, nutritional quality of seed storage proteins, etc. through genetic engineering. Plant tissue culture is being propagated in different species for higher production, disease resistance and quick maturing of fruit crops.

Governmental Measures

Realizing the importance of biotechnology the central government set up the Department of Biotechnology in 1986 in the Ministry of Science and Technology for planning, promotion and coordination of biotechnology programmes in the country. The major tasks of this department are to evolve integrated developmental plan and programmes, identify specific R&D areas, establish infrastructure for advanced research and create a cadre of trained manpower. The biotechnology industry can be divided into conventional and modern categories. Conventional biotechnology industry deals with products like vaccines, diagnostics, antibiotics, biofertilisers, bio-pesticides and fermentation products like yeast, cheese, alcohol, citric acid, lactic acid, and glucose. Modern biotechnology industry deals with genetically engineered products. In the past five years, more than 100 projects involving an investment of over Rs 250 crore were provided by the government. Apart from the national laboratories engaged in agricultural research and state level agricultural universities, many units in the private sector are also interested in research in biotechnology. The consumption of biotechnology products

in India amounted to Rs.1874 crore in 1992, of which products related to animal and human health accounted for 73%, agricultural products for 4% and industrial products for 23%.

Check Your Progress 3

1) What are the benefits of biotechnological research for agriculture?

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2) What measures have been taken by the government to promote the application of biotech in agriculture?

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11.7 LET US SUM UP

It is a fact that all cultivable area in India cannot be irrigated. Thus in a major proportion of cultivable area, we have to rely on natural rainfall. The problem is that the rainfed areas in India are quite diverse in terms of amount of rainfall and soil quality. Therefore, adoption of a uniform crop variety or cropping pattern does not solve the problem. In order to develop the rainfed areas we have to understand the climatic condition correctly, develop crop variety suitable to the climate, and transfer the production technology from lab to land.

Thus agriculture planning in India has adopted a regionally differentiated development strategy. The country has been categorised into a number of homogenous agro-climatic zones. For each region R & D efforts are going on to develop appropriate crops and cropping systems. Biotechnology has played an important role in developing high yielding, water efficient, disease resistant and short duration crops.

11.8 KEY WORDS

Agro-Climatic Zone : An agro-climatic zone refers to areas having similar climatic conditions.

Biotechnology : Biotechnology refers to the use of living organisms for the manufacture of useful products.

11.9 SOME USEFUL BOOKS

Planning Commission, 2003, *Tenth Five Year Plan*, Government of India.

Mal, P., 2001, *Infrastructure Development for Agriculture and Rural Development*, Mohit Publications, New Delhi.

Singhal, V., 1996, *Indian Agriculture*, Indian Economic Data Research Centre.

11.10 ANSWERS/HINTS TO CHECK YOUR PROGRESS EXERCISES

Check Your Progress 1

1) Ultimate irrigation potential in India is limited. Thus cultivation in 74% areas has to depend upon natural rainfall.

2) Rain-fed areas can be of four types: arid, semi-arid, sub-humid and humid. See Sub-section 11.2.1 for details,

3) See Sub-section 11.3.1 and answer.

Check Your Progress 2

1) The purpose of agro-climatic zoning is to study the climate and devise appropriate development strategy, development of appropriate crops through R & D, and adoption of appropriate crop planning.

2) See Section 11.4 and answer.

3) The humid Bengal-Assam basin is characterised by alluvial and latrite soils. In this region the rainfall ranges between 220 cm and 400 cm.

Check Your Progress 3

1) See Section 11.6 and answer.

2) See Section 11.6 and answer.