1

APPLIED AGRICULTURE

Unit Structure:

1.0 Objectives

1.1 Introduction

1.2 Concept

1.3 Nature of Applied Agriculture

1.4 Scope of Applied Agriculture

1.5 Summary

1.6 Questions

1.0 OBJECTIVES

1) To help the students to understand the scope and practical importance of applied agriculture to the small and marginal farmers.

2) To understand the concept of applied agriculture.

3) To study the nature of agriculture.

1.1 INTRODUCTION

Agriculture in India has an extensive background, which goes back to ten thousand years. Till today it is our traditional occupation and also depending on nature to a great extent. Even the distribution of occupations depended on agriculture. Rural areas were self-sufficient and the needs of the people were limited. But during the British rule the small scale and cottage industries were ruined resulting in the increase of population depending on agriculture. The village life was totally disturbed.

As there was very less work and no money in the rural areaspeople started migrating to the urban areas in search of job. This resulted in the decline of traditional occupations in the rural areas. Agriculture gained secondary importance in the rural areas. Farming was not affordable to the small and marginal farmers. This led to a thought of starting other allied activities along with the occupation they were practicing.

Mahatma Gandhi had rightly said, “Agriculture is the Soul of India. Agriculture is the main occupation of Indian rural community.”

As the country’s economic development and progress depends on agriculture it is the need of the hour to recognize the modern techniques and new technology and to accept and implement it. Let us understand what applied agriculture is.

1.2 CONCEPT

India enjoys the second position all over the world in terms of agricultural production. Farming, lumbering, forestry, and fishing represent a high percentage of the Gross Domestic Product of the country. These industries have almost recruited about 50% of the overall manpower of India.

Outputs for every type of harvest have increased since 1950. The government has put particular focus on farming operations in the five-year plans and stable developments in the fields of engineering science, irrigation, implementation of contemporary farming operations, and supply of agricultural loans and grants after the Green Revolution in the country.

Agriculture, with its allied sectors, is the largest livelihood provider in rural India. It also contributes a significant figure to the GDP (Gross Domestic Product). Sustainable agriculture for food security, sustainable technology including soil conservation, natural resource management and biodiversity protection are essential for rural development. India has witnessed a green revolution, a white revolution, a yellow revolution and a blue revolution in agriculture and allied activities.

Nature tends to change, as everything in nature is mortal. Human being also is not exceptional to this change. He has invented many things and has been successful. He has been successful by combining the old and new concepts. Human being accepted the principle of looking practically to the day-to-day activity and gaining profit from that. This is nothing but called applied science.

Applied science is a discipline of science that applies existing scientific knowledge to develop more practical applications,like technology. Within natural science, disciplines that are basic science or pure science develop information to predict and perhaps explain to make us understand—phenomena in the natural world. Applied science applies science to real world practice. In shortbasic science is a method of investigating nature through experimental method trying to satisfy the need to know and applied science is to use pure science for practical human purpose.

The noun form applied can be used in many terms. It can be used in terms of applied arts or applied science as both stress on practical approach or factors. Even in other sectors like industries, commerce and economics applied science is very much used. The need of the hour is to commercialize the agriculture to gain maximum benefit.

Trying to solve different problems in the society with the help of knowledge is nothing but applied sector.

If used in agriculture by using new techniques and technology so as to commercialize the agriculture is called applied agriculture.

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Applied agriculture includes agricultural science, bio- technology, processing industries, tissue culture, horticulture, new cropping pattern, crop protection, bird conservation, soil and water management, agricultural structure and environment, agricultural economics, nutritious diet, dairy occupation, dairy market, animal husbandry, forestry.

If the commercialization of industrial sector is used in agricultural sector, it will boost up and help in making the country's economy stronger. Applied agriculture will help the marginal farmers, small farmers, landless agricultural laborers, and rural artisans, skilled and unskilled laborers. Economic crisis also can be overcome because of applied agriculture.

1.3 NATURE OF APPLIED AGRICULTURE:

While reviewing Indian agriculture we have to consider the pre-independence period and post-independence period. Pre- independence period is the period during the British rule. The British policy was that they never wanted the Indian agricultural sector to be developed as their need was only the raw material produced in the country. The British policy was against the Indian agricultural development. After the partition the fertile land remained in Pakistan.

In order to overcome this food crisis changes were made in the agricultural policy of India. Five-year plans laid more emphasis on agricultural development. In 1966 Green Revolution was successful in the field of agriculture.

In 1965 Food Corporation of India was established. Also agricultural financial corporations, dairy industry on co-operative basis were established, social forestry program was undertaken, and processing industries were started.

Green Revolution, White Revolution, Yellow Revolution, BlueRevolution were successful only because allied and subsidiary occupations were given importance independently along with agriculture. This further can be made more successful with help of applied agriculture.

1.4 SCOPE OF APPLIED AGRICULTURE:

Agriculture is the source of livelihood in India. Commercialization of agriculture will help in eliminating many socialand economic problems in

the society. It is essential to understand the different sections included in applied agriculture.

Applied agriculture includes agricultural science, bio- technology, processing industries, tissue culture, horticulture, new cropping pattern, crop protection, bird conservation, soil and water management, agricultural structure and environment, agricultural economics, nutritious diet, dairy occupation, dairy market, animal husbandry, forestry.

1) Horticulture-

Horticulture is a science of studying garden plants. The wordHorticulture is derived from two Latin words viz. 'Hortus' means garden and 'Culture' means knowledge of growing these crops.

Horticulture is the branch of agriculture that deals with the art, science, technology, and business of vegetable garden plant growing. It not only includes the cultivation of fruits, vegetables, nuts; but also medicinal plants, seeds, herbs, sprouts, mushrooms, algae, flowers, seaweeds and also non-food crops like grass and ornamental trees and plants. It also deals with plant conservation, landscape restoration, landscape and garden design, construction, and maintenance, and arboriculture.

Horticulturists apply their knowledge, skills, and technologies to grow intensively produced plants for human food and non-food uses and for personal or social needs. Their work involves plant propagation and cultivation with the aim of improving not only plant growth; but also yields, quality, its nutritional value, and resistance to insects, pests, diseases, and environmental stresses.

Branches of Horticulture

There are four branches of Horticulture, which are as follows:

A. Olericulture (Vegetable culture): This branch deals with the study of vegetable crops.

B. Pomology (Fruit Culture): This branch of Horticulture deals with study of different fruit crops..

C. Floriculture and Ornamental Gardening: This branch of Horticulture covers flower crops and ornamental plants. It also includes gardening, landscaping and beautification of surroundings.

D. Post-Harvest Technology and preservation: This branch deals with post-harvest management of fruits, vegetables, flowers and its storage along with marketing and preservation and processing.

Importance and scope of Horticulture:

1. Horticultural crops give more returns per unit area than the field crops.
2. Horticulture crops like fruits and vegetables are important as their nutritional value is high with high amount of minerals and vitamins.

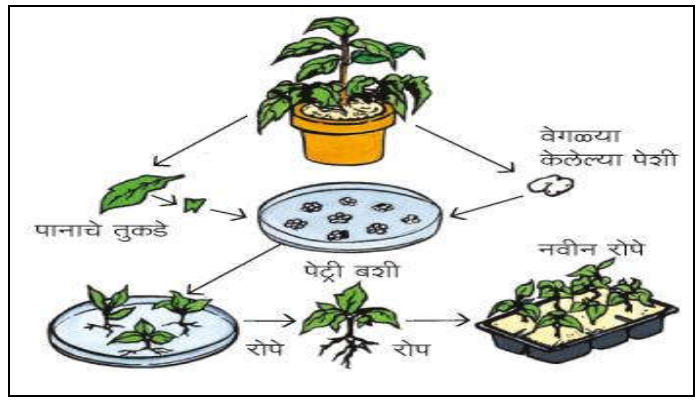
3. Horticulture crop beautifies the surroundings.
4. Horticulture crops are suitable for small and marginal farmers.
5. Variety of crops is available in the Horticulture section with wide range of uses.
6. Horticultural plants reduce pollution, conserve soil and water and improve socio-economic status of the farmer.

Factors affecting the scope of Horticultural crops in India are as follows:

1. The variations in the agro climatic conditions in India, allow growing different Horticultural crops in different regions.
2. Increasing irrigation facilities provide more scope for growing Horticultural crops.
3. Available technical information regarding production of Horticultural crop provides congenial condition to grow these crops.
4. Increase in communication and transport facilities provides greater markets to Horticultural crops.
5. There is good scope for export of fresh and processed products.
6. There is great demand for Horticultural commodities in local markets.
7. Facilities provided by the government help farmers to shift from their traditional crops to Horticultural crops.
8. Development of financial institutions, co-operatives in rural areas help to increase returns from these crops.

2) Plant Tissue Culture

Plant tissue culture is a technique used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition. Plant tissue culture also can be defined as "The culture of all types of plant cells, tissues and organs under aseptic conditions." Different techniques in plant tissue culture may offer some advantages over traditional methods of propagation. They are as follows -



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1. To produce exact copies of plants producing particularly good flowers, fruits, or have some specific desirable traits.
2. To quickly produce mature plants.
3. To produce multiples of plants in the absence of seeds or use necessary pollinators to produce seeds.
4. To regenerate whole plant from plant cells that have been genetically modified.
5. The production of plants in sterile containers that allows them to be moved with very much reduced chances of transmitting diseases, pests, and pathogens.
6. To produce plants from seeds those having very low chances of germinating and growing.
7. To heal particular plants of viral and other infections and quickly multiply these plants as 'cleaned stock' for agriculture and horticulture.

Plant tissue culture is widely used to produce clones of a plant in a method known as Micro-propagation. Over the last 20 years, the Ministry of Science and Technology has supported 150 projects for research and development tissue culture. Through the favorable policies from the Ministries of Science and Technology, Commerce, Industries and Agriculture Government of India has encouraged entrepreneurs and technocrats to set up lots of commercial units. To encourage the tissue culture industry, various central and state government departments have framed several schemes and have announced incentives. Tissue culture technique is developing day-by-day. So once again there is a chance of greenrevolution on large scale in the country.

3) Biotechnology

Biotechnology is the use of living systems and organisms to develop useful products, or "any technological application that uses biological

systems, living organisms or derivatives thereof, to make, modify or process them for specific use". Biotechnology is one of the very highly productive applications of biology where organisms have been modified in order to gain financial benefits.

The main streams that biotechnology deals are cell and tissue culture, genetic engineering, microbiology, embryology, molecular biology, and many other. The cultivation of food plants, producing high-yielding crops, antibiotics, enzymes, and many more other products are also involved in biotechnology. In biotechnology, the organisms are not always modified, but its natural process is enhanced to get the optimum product.

Biotechnology is defined as "any technological application, using biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use." Modern biotechnology uses new techniques that provide much more understanding and control over, living processes. Today, it hasvaried applications, predominantly in the areas of health care, agriculture, environment and industrial processes.

Agriculture

Genetically modified crops or biotic plants are plants used in agriculture, the DNA of which has been modified with genetic engineering techniques. In most of the cases it aimed to introduce anew trait to the plant that does not occur naturally in the species.

Examples in food crops include resistance to certain pests, diseases, stressful environmental conditions, resistance to chemical treatments, reduction of spoilage, or improving thenutrient profile of the crop.

Genetically Modified (GM) crops are foods produced from organisms that have specific changes introduced into their DNA with the methods of genetic engineering. These techniques have allowed the introduction of new crop traits as well as greater control over a food's genetic structure.

The food on the market derived from GM crops poses no greater risk to human health than conventional food. If not used in excess GM crops also provide a number of ecological benefits, However, opponents have objected to GM crops on several grounds, including environmental concerns, whether food produced is safe, whether GM crops are needed to address the world's food needs.

4) Pisciculture or Fish Farming

The breeding, rearing, and transplantation of fish by artificial means is called Pisciculture, in other words, fish farming.Fishing in India is a major industry in its coastal states, employing over

14.5 million people. Fish production in India has increased more than tenfold since its independence in 1947.

The marine fish harvested in India consist of about 65 commercially important species/groups. Pelagic and mid-water species contributed about 52% of the total marine fish in 2004.Indiais a major supplier of fish in the world. Shrimps are one of the major varieties exported. The giant tiger prawn is the dominant species chosen for aquaculture, followed by the Indian white prawn. Farmed shrimp accounted for about 60% of shrimp exported from the country.

Marine and freshwater catch fishing combined with aquaculture fish farming is a rapidly growing industry in India. In 2008 India was the sixth largest producer of marine and freshwater capture fisheries, and the second largest aquaculture farmed fish producer in the world. As of 2010, fish harvest distribution wasdifficult within India because of poor rural road infrastructure, lack of cold storage and absence of organized retail in most parts of the country.

The country's rich marine and inland water resources with fisheries and aquaculture offer an attractive and promising sector for employment, livelihood, and food security. Fish products from India create export-driven employment opportunities in India and provide greater food security for the world. The Indian fisheries and aquaculture has witnessed great improvements in craft, tackle and farming methods during the past decades. Creation of required harvest and post-harvest infrastructure has received due attention of the central and state governments. The culture systems adopted in the country vary greatly depending on the input available in any particular region as well as on the investment capabilities of the farmer.

The different culture systems in Indian practice include-

a. Intensive pond culture with supplementary feeding and aeration

b. Composite carp culture

c. Weed-based carp poly-culture

d. Integrated fish farming with poultry, pigs, ducks, horticulture,etc.

e. Pen culture

f. Cage culture

g. Running-water fish culture

In India, two types of aquaculture are practiced - freshwater aquaculture and brackish water aquaculture. Freshwater aquaculture involves the breeding of freshwater fish like carp, katla, rohu, mrugal, freshwater prawn, freshwater pearl culture and ornamental fish farming. Brackish water aquaculture involves breeding of fish that habitat the sea like sea bass, grey mullet, tiger shrimp and mud crabs. The water in which fish are farmed is important for the development of a good harvest. The farmer should monitor the level of water hardness, acidity / alkalinity, contaminants, industrial chemicals and pesticides in the water. He should

also ensure that there is enough dissolved oxygen in the water for the survival of aquatic life.

Fish as food—both from fish farms and catch fisheries— offers India's one of the easiest and fastest way to address malnutrition and food security.

5) Bee-Keeping and Sericulture-

Beekeeping or apiculture is the maintenance of honey bee colonies, commonly in beehives, by humans. A location where bees are kept is called an apiary or "bee yard". A beekeeper or apiarist keeps the bees in order to collect their honey and other products like beeswax, propolis, pollen, royal jelly that the hive produces to pollinate crops, or to produce bees for sale to other beekeepers. Related to natural beekeeping, urban beekeeping isan attempt to revert to a less industrialized way of obtaining honey by utilizing small-scale colonies that pollinate urban gardens. A growing trend of urban beekeeping is seen by many and have found that city bees are more healthier than the rural bees as there are very less pesticides and greater biodiversity. An environment of year-round, uninterrupted bloom creates an ideal environment for colony reproduction.

Sericulture, or silk farming, is the rearing of silkworms for theproduction of silk. Although there are several commercial species of silkworms, Bombix mori is the most widely used and intensively studied silkworm. Sericulture has become an important cottage industry in India. Today, China and India are the two main producers, with more than 60% of the world's annualproduction. Sericulture is both an art and science of raising silkworms for silk production. Silk reigns supreme as an object of desire and fabric of high fashion. Being a rural based industry, the production and weaving of silk is largely carried out by relatively poor sections of the society and this aspect of sericulture has madeit popular and sustainable in India.

Both these occupations create employment on large scale giving rise in income and also gain foreign currency.

6) Forestry-

Forestry in India is a significant rural industry and a major environmental resource. India is one of the ten most forest-rich countries of the world.

India produces a range of processed forest (wood and non- wood) products ranging from wood panel products and wood pulp to make bronze, rattazikistan ware and pern resin, furniture and craft industry India is one of the world's largest consumer of fuel- wood. India's dependence on fuel-wood and forestry products as a primary energy source is not only environmentally unsustainable, it is a primary cause of India's near-permanent haze and air pollution. Forestry in India is more than just about wood and fuel. India has a thriving non-wood forest products industry, which produces latex, gums, resins, essential oils, flavors, fragrancesand aroma, chemicals, incense sticks, handicrafts, thatching materials and medicinal plants.

The government nationalized the forests in 1953. Most of the forest wood industry and non-wood forest products industry were nationalized. The Conservation Act of 1980 stipulated that the central permission is required to practice sustainable agro-forestry in a forest area. These nationalization wave and laws intended to limit deforestation, conserve biodiversity, and to save wildlife.

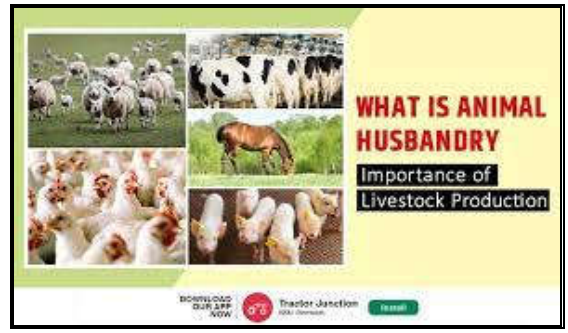
Economics

Significant forest products of India include paper, plywood, saw wood, timber, poles, pulp and matchwood, fuel wood, Sal Seeds, Tendu leaves, gums and resins, cane and rattan, bamboo, grass and fodder, drugs, spices and condiments, herbs, cosmetics, tannins. Since the early 1970s, as the people realized that deforestation threatened not only the ecology but their livelihood ina variety of ways, they have become more interested and involved in conservation. Chipko movement in India started in the 1970s around a dispute on how and who should have a right to harvest forest resources. Indian forests are more than trees and an economic resource. They are home to some of earth's unique flora and fauna. Social forestry program was started in 1976 so as to gain peoples participation in planting trees. In this program trees planted are useful to the community. Motive of ecological balance with economic development is achieved through this program. Other benefits obtained from this program are fodder for animals, wood for fuel and for construction purpose. Even barren lands are covered under social forestry program so as to gain benefits.

7) Animal Husbandry:

The branch of agriculture that deals with the feeding caring and breeding of domestic animal is called Animal Husbandry. Husbanding means to use a resource carefully and without wasting. Animal husbandry is the management and care of farm animals by humans, where in genetic qualities and behavior, is further developed and are considered to be advantageous to humans.

Animal husbandry plays an important role in the rural economy. A large number of farmers in India depend for their livelihood on animal husbandry. Mainly bullocks are the major source of power for the farmers and dryers in addition to supplying



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animals, milk, meat, eggs, wool and hides. Domestic animals or livestock are also helpful in agriculture. Animal farming or animal husbandry requires planning for domestic animals shelter, breeding, health, disease control and proper economic utilization. Livestock are domesticated animals raised in an agricultural setting to produce food, fiber and labor. Livestock being useful animals are reared for commercial purpose and financial gains. In recent years, livestock are also raised for the promotion of survival of rare breeds.

Goat is known as 'Poor man's cow' in India. It is a very important component in dry land farming system. Marginal lands not suitable for other types of animals like cow or buffalo, goat is the best alternative. With very low investments goat rearing can be made in to a profitable venture for small and marginal farmers. Goats are reared for milk and meat. Goat is a multi- functional animal and plays a significant role in the economy and nutrition of landless, small and marginal farmers in the country. Goats can efficiently survive on available shrubs and trees in adverse harsh environment in low fertility lands where no other crop can be grown. Around the world, more people drink goat milk than cow milk. An allergy to goat milk is very rare.

Sheep rearing is the raising and breeding of domestic sheep. It is a branch of animal husbandry. Sheep are raised principally for their meat, milk, and wool. Sheep's that have grown old or are unproductive are sold out to gain more profit. Every year 20-30% sheep's that are not useful are sold out and get an additional income. Sheep shearing is also considered a sport with competitions held around the world. Pig farming is a branch of animal husbandry dealing with the raising and breeding of domestic pigs. Pigs are raised principally as food (e.g. pork, bacon, gammon) and sometimes for their skin.

Pig farm activities depend on the husbandry style of the farmer. It ranges from very little intervention (as when pigs are allowed to roam villages or towns and dispose of garbage) to intensive systems where the pigs are kept in a building for the majority of their lives. Each pig farm will tend to adapt to the local conditions and food supplies and fit their practices to their specific situation. Pigs are valued as a source of meat, fat and for their ability to turn inedible food into meat, and often fed household food waste if kept on a homestead. Pigs have been farmed to dispose of municipal garbage on a large scale. The majority of pigs are used for human food and also for their skin, fat and other materials for use as clothing, ingredients for processed foods, cosmetics and other and medical use. Dairy Occupation.

A dairy is a business enterprise established for the harvesting or processing of animal milk or both mostly from cows or goats, but also from buffaloes, sheep, horse or camels for human consumption. Dairy activities have traditionally been an integral part of India's rural economy. India is the world's largest producer of dairy products and also the largest consumer. Almost its entire produce is consumed in the domestic market. Even though India is the world's largest producer of dairy products, the

dairy sector is not yet fully developed or modernized. Indian breeds of cows are considered inferior in terms of productivity. Moreover, the sector deals with many other problems like shortage of fodder, its poor quality, dismal transportation facilities and a poorly developed cold chain infrastructure. As a result, the supply side lacks in elasticity that is expected of it.

Fortunately, the government and other stakeholders have shown concern regarding this situation and efforts to increase milk production have been intensified. Transformations in the sector are being induced by factors like newfound interest on the part of the organized sector, new markets, easy credit facilities, dairy friendly policies by the government, supply of fodder, production of green fodder on large scale, disease control, training to the dairy farmer, training in management skills, production of hybrid variety of animals giving more yield, etc. Dairy farming is now evolving from an agrarian way of life to a professionally managed the Indian dairy industry. With these positive signals, there is hope for another white revolution.

8) Dairy Market

If proper market is provided to the dairy occupation economic development of the rural areas will be very fast. As milk is a perishable item it has to reach the desired destination in time. Even the processed milk products should reach the market in time and also to the consumers. For this milk centers on co-operative basis and also private milk processing centers are functioning.

9) Poultry Farming

Poultry farming means raising domesticated birds like chickens, ducks, turkeys and geese for the purpose of farming, meat or eggs for food. Poultry also includes other birds that are killed for their meat, such as the young of pigeons, but does not include similar wild birds hunted for sport or food and known as game.

The domestication of poultry took place several thousand years ago and keeping the birds permanently in captivity. Soon it was realized how useful it was having a captive-bred source offood. Although some birds are still kept in small flocks in extensive systems, most birds available in the market today are reared in intensive commercial enterprises. Poultry is the second most widelyeaten type of meat globally and, along with eggs, provides nutritionally beneficial food containing high-quality protein accompanied by a low proportion of fat. This has become a boon to the rural unemployed people especially young generation. Poultry has helped to minimize unemployment to an extent.

10) Processing Industry

Processing industries are very important in India as majority people in rural areas depend on agriculture for their livelihood.Processing industries play an important role in minimizing unemployment and disguised

employment in the country along with maintaining geographical balance. Different processing industries are seen in different areas having different climatic conditions in the country. For examples processing industries are based on the products like sugarcane, cotton, tobacco, rubber, tea, coffee, cocoa, jute, different types of fruits, coconut, oil-seeds.

Forest based industries, sericulture, industries based on spices, woolen industries; dairy are some of the industries providing employment opportunities to the rural people. Continuity in the production and stable price, have helped to eliminate poverty and unemployment to large extent. This also has helped to keep regional balance along with reduction of migration from rural to urban areas and in turn raise in the income of rural people. Transport and communication facilities have helped in rural savings. Primary facilities have increased to a great extent.

Still there is lot of scope to establish industries processing on raw the available raw material. This in turn will raise the standard ofliving of rural people and overall change can be brought out.

11) Soil and Water management

In today's situation it is very important to practice scientific farming. New technique and technology has to be used to its fullest. Soil and water play an important role in the increase of agricultural production. For this it is very essential to know the soil type and its requirement. For this the soil has to test in the lab. A record ofthe soil ingredients, its PH value, the chemicals present, its salinity, presence of nitrogen, sulphur, potassium, calcium, magnesium, sodium, lead, boron, copper, iron etc. is kept. Even the fertility of soil, capacity to hold water, wetness in the soil, density of the soil particles etc. is seen.

Water also like soil management keeps record of the quality of water. Water salinity, presence of calcium, magnesium, sodium, potassium, chloride, sulphate, bi-carbonate, carbonate, etc. are the criteria to decide the quality of water.

Soil and water management helps the farmer to understand to know their quality, so that he can take measures to improve them, add the necessary ingredients to increase the fertility of soil and the quality of water. In return he can increase the production on a large scale. Soil and water management will help him decrease the production cost, and also save 30 – 40% water.

12) Cropping pattern and environment

Water supply, type of soil, climate and other factor are taken into consideration while doing the agricultural operations. The different patterns of sowing the crops are kharif crops, seasonal crops, rabbi seasonal crops, summer crops that are seasonal and crops taken during the whole year. Farmers get expected production only when the climate and temperature is favorable.

13) Agricultural Scientist and science

Agricultural scientist is needed to do research in agricultureto invent new technique and technologies for agricultural operations that would be beneficial to the farmers. Research should also be done in the field of animal husbandry, dairy, poultry, pisciculture, tissue culture, horticulture, nursery etc.

Indian agricultural research conference, Indian agricultural research institutes are functioning and doing research in the fields of rice, potato, tea, dairy, sugarcane, cotton, forest, animal husbandry, vegetables and lac research. Indian government has established centers and sub centers to do research in the fields of sugarcane, cotton, jute, oil-seeds, coconut etc. It is the result of the research that India has developed in various fields of agriculture. So we can say there is great scope for applied agriculture in our country.

14) Agricultural Economics

Application of principles of general economic to agriculture is called as agricultural economics.

Importance of agriculture in the National Economy:

India is an agricultural country, and 70% population dependson agriculture and is the main source of income. The contribution ofagriculture in the national income in India is more, so we say that agriculture is the backbone of Indian Economy.

1) Share of agriculture in the national income:

Agriculture contributes a major share in the national income of India. But it is seen that the share of agriculture in national income has been decreasing. This steady and gradual decline is due to the rapid Industrialization in the country.

2) Agriculture as a source of livelihood:

About 65 to 70 per cent Indian population depends on agriculture as a source of livelihood.

3) Importance of agriculture in industrial development:

Many industries depend on the available agricultural raw material e.g. sugar industries, Cotton Industries, Paper Industries, tobacco industries, Chilies, turmeric etc. Many industries supply theinputs to the agricultural industry e.g. fertilizers, insecticides, pesticides, implements and machineries like tractors etc.

4) Role of agriculture in the field of International trade:

Many agricultural products like tea, sugar, oilseeds, tobacco, spices contribute the major share in export. We also are exporting basmati rice, some fruits, vegetables and flowers to the many other countries. Many

agriculture products like food-grains, fruits are transported by roadways and railways. Thus, providing employment to many people in this field. We can say that the prosperity of the country depends on the prosperity of agriculture.

1.5 SUMMARY

Sustainable agriculture for food security, sustainable technology including soil conservation, natural resource management and biodiversity protection are essential for rural development.

Agriculture is the source of livelihood in India. Commercialization of agriculture will help in eliminating many socialand economic problems in the society. It is essential to understand the different sections included in applied agriculture.

Applied science is a discipline of science that applies existing scientific knowledge to develop more practical applications, like technology. Applied science applies science to real world practice. In short basic science is a method of investigating nature through experimental method trying to satisfy the need to know andapplied science is to use pure science for practical human purpose. All the above factors are included in scope of appliedagriculture. If applied agriculture is used as an occupation in the true sense rural development can be achieved to its maximum.

1.6 QUESTIONS FOR SELF-STUDY

1) Explain the concept of applied agriculture.

OR

What is applied agriculture?

2) Explain in detail the scope of applied agriculture.

3) Give the importance of agriculture in national economy.

4) Write short notes on:

a) Applied agriculture

b) Horticulture

c) Plant tissue culture

d) Pisciculture

e) Beekeeping or sericulture

f) Animal Husbandry

g) Dairy occupation

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2

AGRO-ECOLOGY-I

Unit Structure:

2.0 Objectives

2.1 Introduction

2.2 Agro-Ecology-meaning

2.3 Agro-Ecology-definition

2.4 Principles of Agro-ecology

2.5 Scope of Agro-Ecology

2.6 Importance of Agro-Ecology

2.7 Summery

2.8 Questions for self-study.

2.0 OBJECTIVES

1) To understand meaning of Agro-Ecology.

2) To know the definition of Agro-Ecology.

3) To understand the relation between ecology and farming methods.

4) To know the Principles of Agro-ecology

5) To know the importance of agro-ecology.

2.1 INTRODUCTION

Before starting the topic agro-ecology, we will try to understand the world wide situation, regarding ecology and activities of human being and its effects on man and its environment. Humans have stated various activities on earth like industrialization, urbanization, space activities and so called modern agricultural practices. Today's agriculture practices are making great adverse effect on the ecology of many species. Humans on earth are also suffering and facing lots of challenges, even after great achievements of science and technology. Hunger, malnutrition, climate change, biodiversity loss and environmental degradation have led to increased focus on the world's food system in recent years. All these issues are interconnected with environment and ecology.

agroecologyen

In this context, agro-ecology is the topic, on which human being need to focus keenly to avoid future problems in front of coming generations. The term agro ecology began to be used in scientific publications in Europe and the US in the late 1920s, when scientists started to combine principles from ecology and agronomy in an attempt to better understand different agricultural systems.1 Perceiving the field and the farm as 'domesticated ecosystems', scientists focused on the interactions between plants, animals, soils and climate to develop knowledge on, among other things, nutrient cycling, biodiversity and energy efficiency in crop production. The science of agro ecology initially focused on the environmental impacts of different productive systems at the scale of the field or the farm, and in certain contexts, for example Germany and parts of Europe, this is predominantly still the case.1,3 In other parts of the world however, particularly the Americas, academic understandings of agro ecology have broadened to incorporate 'the ecology of the entire food system'. Many scholars working on the topic now reject purely scientific or technical understandings of agro ecology, and instead promote a trans disciplinary, participatory, action-oriented approach combining insights from natural, environmental and social sciences.

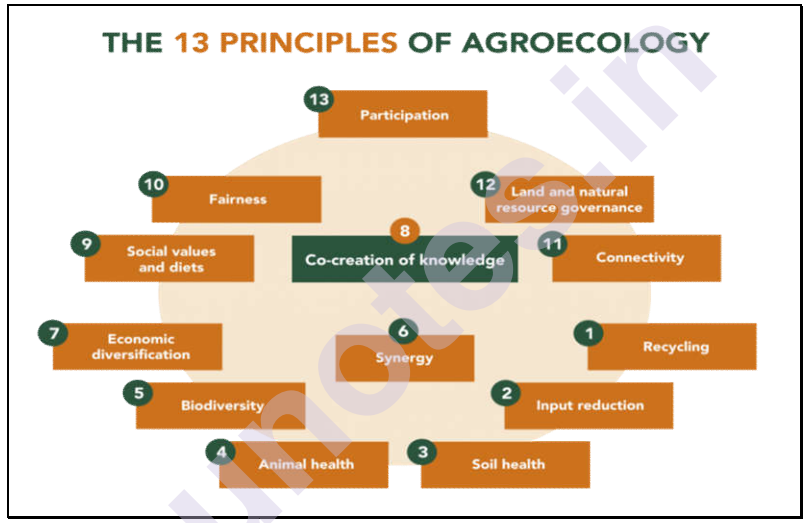
2.2 AGRO-ECOLOGY MEANING:

Agro-ecology is a science that draws on social, biological and agricultural sciences and integrates these with traditional knowledge and farmer's knowledge. This gives rise to basic principles that materialized in specific technological forms. At the heart of the agro ecology strategy is the idea that an Agro ecosystem should mimic. The functioning of local ecosystems, thus exhibiting tight nutrient cycling, complex structure and enhanced biodiversity. The expectation is that such agricultural mimics, like their natural models, can be productive, pest resistant and conservative of nutrients. Come. Learning from nature allows development of agro ecosystems with a minimum dependency on agrochemical inputs and energy, emphasizing interactions and synergism, among the many biological components, of agro systems to enhance recycling and biological control, Thus improving overall ecological efficiency and environmental production.

Agro-ecology, which uses, ecological concepts and principles, for the design and management, of sustainable agriculture systems, has consistently proven, capable of sustainably increasing. The total output of diversified firms and has far greater potential for fighting hunger, particularly during economically and climatically uncertain times, without depleting environment.

In other words, Agro ecology is a technique of sustainable farming that focuses on utilizing natural resources comprehensively without letting them be susceptible to damage. With this type of farming at hand, farmers can instantly develop better solutions to improve their environmental and economic pressures.

Agro ecology seeks to optimize the relationships and interactions between animals, plants, people, and the environment while addressing social issues for a fair and sustainable food system.



https://wle.cgiar.org

2.3. AGRO-ECOLOGY DEFINITION

"Agro ecology" is an interdisciplinary combination of agronomy, agriculture, scientific ecology, economics, and social sciences. It integrates practices such as organic farming, regenerative agriculture, and some aspects of permaculture and therefore contributes to sustainable development."

"Agro-ecology can also be defined as the study of applying the most efficient ecological processes to agricultural production systems. It is similar to sustainable farming, a scientific framework integrating human socio-economic systems and ecological concepts into agricultural operations."

2.4. PRINCIPLES OF AGRO-ECOLOGY

In aiding the transformation of food and agricultural systems to sustainable agriculture on a large scale and achieving zero-hunger, 10

principles of agro-ecology; were developed. diversity, synergy, co-creation, and sharing of knowledge, efficiency, resilience, recycling, human and social values, responsible governance, culture and food traditions, and circular and solidarity economy.

1. Diversity: Diversification is important in transitioning agro-ecological processes to ensure food nutrition and security while protecting, conserving, and enhancing natural resources. Agro-ecological systems are very diverse, and they optimize the diversity of genetic resources and species in different ways.

Agro-ecological diversification strengthens socio-economic and ecological resilience, like creating new market opportunities. Having a diversified source of income from new and differentiated markets helps stabilize household incomes.

2. **Synergy**: Developing synergies help enhance key functions across food systems and support the production and multiple ecosystem services.

Agro-ecology focuses on designing diversified systems that combine perennial and annual crops, aquatic and livestock animals, soils, trees, water, and other components that enhance synergies within an increasingly changing climate.

By optimizing biological synergies, agro-ecological practices enhance ecological functions, resulting in greater resource-use efficiency and resilience. By maximizing synergies, food crops significantly improve yields, weed control, dietary diversity, soil structure, fertility, pest control, and biodiversity habitat.

3. Co-Creation and Sharing of Knowledge: There is a better response to local challenges when agricultural innovations are co-created through participatory processes.

Agro-ecology depends on context-specific knowledge; it does not offer fixed prescriptions. Instead, agro-ecological practices are tailored to fit the social, environmental, cultural, political, and economic context.

Through co-creation, agro-ecology blends indigenous and traditional knowledge with traders' and producers' knowledge and global scientific knowledge.

Encouraging participatory processes and institutional innovations that develop mutual trust enables sharing knowledge and co-creation that contributes to relevant agro-ecological processes.

4. Efficiency: By implementing agro-ecological practices, we can achieve more while utilizing fewer external resources. Agro-ecological systems improve the use of natural resources, especially those in abundance, and are free, like atmospheric carbon, solar radiation, and nitrogen.

Producers can reduce costs, use fewer external resources, and reduce the negative environmental impacts of external resources by enhancing biological processes and recycling nutrients, biomass, and water.

Producers can increase autonomy and resilience to natural and economic shocks by reducing dependency on external resources.

5. Resilience: Agro-ecology enhances the resilience of communities, people, and ecosystems to sustain food and agricultural systems. Having a diversified agro-ecological system is more resilient because there is a greater capacity to resist pests and disease attacks and recover from unfortunate disturbances, like extreme weather events.

By maintaining a functional balance, agro-ecological systems can resist pests and disease attacks and promote a necessary community of interacting organisms to self-regulate pest outbreaks.

Agro-ecological practices also enhance socio-economic resilience. Producers can reduce vulnerability through integration and diversification.

6. Recycling: In the natural ecosystem, there is no such thing as waste; it is a human concept and the unwanted residue left behind after human activities. Recycling can be done on both landscapes and farm-scale settings through diversification and the building of synergies between different components and activities.

Agro-ecology imitates the **natural ecosystems** in supporting biological processes that propel biomass, water, and nutrients recycling within production systems, minimizing pollution and waste while increasing efficiency**.**

vikral.com

7. Human and Social Values: Agro-ecology emphasizes human and social values, including equity, dignity, justice, and inclusion, which contribute to improved livelihoods.

By encouraging autonomy and adaptive processes to manage agro-ecosystems, agro-ecological processes empower people and communities to overcome hunger, poverty, and malnutrition while promoting human rights.

8. Responsible Governance: Effective governance mechanisms at different scales, from local to national to global, are important in implementing sustainable food and agricultural practices.

An accountable, transparent, and inclusive governance system is essential in creating an enabling environment that supports producers to transition their systems to agro-ecological practices and concepts.

9. Culture and Food Traditions: Agro-ecology contributes to food nutrition and security while maintaining the health of the ecosystem when healthy, diversified, and culturally appropriate diets are supported.

Some major components of human heritage are food and agriculture, so they play a vital role in shaping human behavior. Agro-ecology rebalances modern and traditional food habits and brings them together to promote healthy food production and consumption.

10. Circular and Solidarity Economy: A circular and solidarity economy assists in living within the planetary boundaries while ensuring a social foundation for sustainable and inclusive development.

Agro-ecology reconnects producers and consumers through a circular and solidarity economy, prioritizing local markets and supporting local economic developments.

2.5. SCOPE OF AGRO-ECOLOGY:

Generally, agro-ecology can be classified into five different levels. This was created by Gleissman, who used his brilliant mind to transform food systems into diverse groups.

While the first three are based on local practices, the remaining involves the food system. All of these levels are significantly helpful that farmers can use to transform their farms into conventional agro-ecosystems.

Improves Existing Practice Efficiency

This is the level that focuses on the improvement of current practice efficiency. Every industrial input like fertilizers is tried to make efficient so that its harmful effects can be reduced considerably.

Over the years, many researchers have studied this approach, and it works like magic. That is what has been able to create several innovations in this field.

Improvement in seed, planting design, and intelligent application of farm chemicals are some of the changes that have occurred under this level. So, it can be advantageous.

Change Inputs and Practices

At this level,

Agro-ecology focuses on creating renewable, eco-friendly, and naturally sourced practices for better efficiency and benefits. So, it typically embraces the idea of Organic farming. This concept is similar to keeping a check on our daily diet to foster well-being. So, instead of using synthetic nitrogen fertilizers, we could replace them with nitrogen-fixing cover crops. Incorporating natural pest control and organic compost could also help foster soil fertility more dramatically in the long run.

Restructuring the Agro-ecosystem

Level 3 incorporates extensive research on diverse factors relating to the entire system of conversions. It also helps understand the primary yield-limiting aspects to be noticed.

To help bring the suitable design alterations into action, continued research is conducted in agro-ecological design, function, and structure. Reintroduction of farm biodiversity could be a great example of level 3 implementation. Agroforestry, multiple cropping, and permaculture could also be significant actions to implement here.

Foster Improved Relationships

At this point, organic farming culture expands, and people are encouraged to consume home-grown foods. The purchasing and eating of in-grown and processed foods locally is a good practice at this level.

Food citizenship occurs by performing these significant steps that become the trailblazer to push agro-ecological changes in the food system.

By focusing on this level of agro-ecology, a lot of things can change for the better. Also, the relationship between local growers and consumers can get better.

Build a Better Tomorrow

At this level, it becomes significant for you to focus on curating a new global food system that goes beyond the usual measures. So, your focus should be on creating sustainability that proceeds towards the path of restoration.

This way, you can help make the most of your natural resources and protect the Earth. So, creating a sustainable food system no longer feels like a tedious task.

This is a deeper level of agro-ecology that can transform the entire food system. It encourages the idea of embracing sustainability and dumping unnecessary food wastage.

2.5. IMPORTANCE OF AGRO-ECOLOGY

Introduction: Agro-ecology is very different from other approaches to achieving sustainable development because it is based on territorial and bottom-up processes. It combines science with traditional, practical, and local producers' knowledge.

Instead of improving unsustainable agricultural practices, agro-ecology seeks to transform agricultural systems by addressing the root cause of the problems in an integrated way and providing effective and long-term solutions as under:

i) **Improves the Soil Health**: There are different agro-ecological methods to improve agricultural practices. One of which is Integrated Soil Fertility Management, which relies on the combination of mineral and organic fertilizer to achieve optimum soil health. Agro-ecology improves the health of the soil so natural functions can be performed easily. To grow

https://grocycle.com

healthy crops, the soil must be healthy, and with agro-ecology, the soil is improved, making the growth and production of crops efficient.

ii) **Economic Development**: Regardless of how developed a country is, if the agricultural industry is not advancing, every part of the country will be affected.

Implementing agro-ecology practices boosts the economy of every country because there will be a massive reduction in the application of outputs like pesticides and chemicals. This will give rise to the development of other industries.

iii) **Improves Quality of Life**: Agro-ecology recognizes and accepts the multi-functional aspects of agriculture, local, and indigenous practices and knowledge.

So, with agro-ecology, farming is not only improved, but there are also benefits to the social, cultural, and environmental aspects of life. Producing food by implementing agro-ecology will result in enough food to feed the ever-increasing population of man.

iv) **Increases Efficiency**: Agro-ecology involves using efficient processes that reduce the inputs of industrial products and their adverse effects.

The methods used in agro-ecology are the effective use of water, better seeds, planting density, design, and efficient use of farm chemicals. These processes reduce the negative effects of agriculture on the environment and improve efficiency.

v) **Improved Agricultural Operations:**

Agro-ecology seeks to change the input-intensive and environmentally harmful practices and services to renewable, eco-friendly, and naturally sourced practices. Instead of relying on the old, traditional agricultural processes that have various negative impacts on the environment, food grown, and people, there are better practices that are safe.

2.6. SUMMERY

Today's agriculture practices are making great adverse effect on the ecology of many species. Humans on earth are also suffering and facing lots of challenges, even after great achievements of science and technology. Hunger, malnutrition, climate change, biodiversity loss and environmental degradation have led to increased focus on the world's food system in recent years. All these issues are interconnected with environment and ecology.

Most of the social, economic, and environmental crisis we face in the world today is a result of the way we organize our food systems. And by implementing agro-ecological processes, we have a way to respond to instability and meet a significant increase in our food needs without causing any economic, environmental, or social damage.

2.7. EXERCISE

Q.1. Explain the meaning of Agro-Ecology.
Q.2. Write the definition of Agro-Ecology and state its importance in human health.
Q. 3. State the relation between ecology and farming methods.
Q.4. Elaborate the various Principles of Agro-ecology.
Q.5. Write the importance of agro-ecology.

❖❖❖❖

3

AGRO-ECOLOGY-II

Unit Structure:

3.1. Objectives

3.2. Introduction

3.3. Zero Budget Farming

3.4. Bio-farming

3.5. Mix cropping pattern

3.6. Summary

3.7. Exercise.

3.1. OBJECTIVES

i). To understand meaning of Zero budget faming.
ii) To know the definition of Zero Budget Farming.
iii) To understand the relation between ecology and bio farming.
iv) To know the importance of mix cropping pattern in farming.

3.2. INTRODUCTION

Agroecology is an integrated approach that applies ecological and social concepts to the design and management of food and agricultural systems. Agroecology has some common principles and basic approaches that rely on nature's wonderful and complex processes and products. This is regardless of what a particular school of agroecology—organic farming, bio-dynamic farming, permaculture, natural farming, Subhash Palekar Natural Farming (SPNF), Zero Budget Farming (ZBF), NatuEco farming, adivasi traditional farming—might propagate in terms of practices and techniques to be adopted at the farm level.

However, there has been a raging debate around ZBF, starting from the time that the Andhra Pradesh government announced that it would use this approach to scale up agroecological agriculture in the state.

This debate became louder when the Government of India announced its support to ZBF through the Finance Minister's Union Budget speech and recently, in the UNCCD Conference when the Prime Minister himself made a mention of ZBF. Plus, certain sweeping, preposterous, and invalid statements made by Subhash Palekar on some matters did not help; now it is agroecology proponents and organic farming activists that are attacking ZBF, not just the pesticides/fertilisers industry or conventional-intensive-agriculture-supporters like National Academy of Agricultural Sciences (NAAS).

I make a clear distinction between SPNF and ZBF as is being scaled up in Andhra Pradesh, in explaining why I support the government's move to promote ZBF. I would also like readers to know that I am basing my statements on recent visits to at least ten villages of the Andhra Pradesh ZBF programme in Anantapur, Cuddapah, and Vizianagaram districts, and detailed interactions with around 90 farmers and programme functionaries in all.

3.3. ZERO BUDGET FARMING

The concept was promoted by an agriculturist, Padmashri. Subhash Palekar, in the mid-1990s as an alternative to the Green Revolution's methods driven by chemical fertilizers and pesticides and intensive irrigation. Recently Government of India has taken cognisance of the method and principles behind the agricultural practices mainly to deal with the issues of suicides of farmers in the country, and continuous demand of support price for the agricultural goods.

Agriculturalist Mr. Subhaash Palekar focuses on cost of production of the agricultural produce, which is day by day continuously increasing because of capitalist approach. Today such approach is not affordable to the small and marginal farmers in the country.

Mr. Palekar"s some basic principles behind the practices are:

PRINCIPLES OF ZERO BUDGET FARMING:

i) No external inputs.

ii) Use of local varieties.

iii) Mixed cropping.

iv) Microbial Seed treatment.

v) Integration of trees into the farm..

vi) Microbial inoculants for soil health

vii) Crops covering method: Cover crops for biomass mulching and bio-mass incorporation for creating a suitable micro-climate for maximum beneficial microbial activity.

viii) Integration of trees: into the farm.

ix) Integration of livestock: Integration of livestock, especially of native breed for cow dung and cow urine as essential inputs for several practices.

x) Water conservation: Water conservation and moisture conservation.

Four main Elements and Model of ZERO BUDGET FARMING:

1. BIJAMRITA -Seed Treatment using local cow-dung and cow urine

The seeds are treated with formulations prepared using cow dung and cow urine from native cow species as they have higher adaptability to our local climatic conditions and easy to maintain by the small and marginal farmers. While Bijamrita is used for seed treatment, extracts of Neem leaves and pulp, tobacco and green chillies are used for insect and pest management.

Benefits: The seeds sown in the field may be affected by fungus and other seed born/soil born diseases. The seed treatment using "Bijamrita "protects the seeds from diseases.

https://rainwaterrunoff.com

2. Jiwamrita/Jeevamrutha

Cow dung is a natural source used to revive the fertility and nutrient value of soil. One gram of cow dung may have between 300 to 500 crore beneficial micro-organisms. These micro-organisms assists in decomposing the biomass present in the soil and convert it into available/ready-to-use nutrients for crop.

Jiwamrita is prepared using Cow dung and cow urine. It is used as an input for the plants. It is a fermented microbial culture obtained from cow dung, urine, jaggery, pulse flour and uncontaminated soil. This fermented microbial culture when applied to soil, adds nutrients to the soil besides acting as a catalytic agent to promote the activity of microorganisms and earthworms in the soil. About 500 litres of jeevamrutha should be sprayed twice a month per hectare of land; after three years, the system is supposed to become self-sustaining. One indigenous cow is sufficient for 30 acres of land.

Benefits: This culture will be applied in soil instead of chemical fertilizers. This culture stimulates microbial activity in the soil and enhances nutrient availability for the plants, protects the crops against soil pathogens and increases carbon content of the soil.

3. Mulching

Mulching is the process of covering the top soil with crop wastes/organic waste or with cover crops

Benefits: Mulching materials decomposes and produces humus which conserves top soil, increases water retention capacity of the soil, decreases evaporation loss, encourages soil fauna besides enriching soil nutrient status and controlling weed growth.

4. Waaphasa (Soil Aeration).

Good aeration is required in the soil for plant growth and development. ZBNF concept opposes the use of vermi compost as it introduces the most common composting worm the European Red Wiggler to Indian soil, which absorbs toxic metals and poisons ground water and soil.

Benefits: Due to the application of Jiwamrita and mulching, the aeration of the soil increases, thus improves humus content, water availability, water holding capacity and soil structure which is most suitable for crop growth especially during drought periods.

ZBF- Cropping Model

The model is based on raising poly crops i.e., growing short duration and long duration crops (main crop) together so that the cost of raising the main crops will be recovered from the income generated from the short duration crops resulting in "zero" expenditure for the main crop. Hence the term "Zero Budget Farming "is used for this farming model.

Why ZBF?

National Sample Survey Office (NSSO) data indicates that more than 70 % of the agricultural households spend more than they earn and more than 50 per cent of all farmers are in debt due to increased cost of farm inputs like fertilizers and chemical pesticides.

In order to achieve the Central Government aim to double the farmer's income by 2022, the farm expenditure is to be brought down and natural farming like ZBF has to be encouraged to reduce the dependence of the farmers on external inputs like chemical fertilizers and pesticides, which they cannot afford. Moreover, intercropping also increases the farm returns.

Zero budgets farming model brings down farm expenditure to a greater extent and ends dependence on farm loans. It also reduces dependence on purchased inputs as it encourages use of own seeds and locally available natural fertilizers and farming is done in synchronization with nature.

Government Initiatives to support ZBF:

Government of India has been encouraging organic farming through various schemes like Paramparagat Krishi Vikas Yojana (PKVY) since 2015-16 and also through Rashtriya Krishi Vikas Yojana (RKVY).

In the revised guidelines of PKVY scheme during the year 2018, various organic farming models like Natural Farming, Rishi Farming, Vedic Farming, Cow Farming, Homa Farming, Zero Budget Natural Farming (ZBF) etc. have been included and flexibility is given to state governments to adopt any model of Organic Farming including ZBF depending on farmer's choice.

In June 2018, Andhra Pradesh Government rolled out a plan to become India's first state to practice 100 % natural farming by 2024 by converting state's 60 lakh farmers to ZBF method.

To take this further, Union Finance Minister Nirmala Sitharaman also announced a proposal of zero budget farming in her first Budget speech, which she said is like "going back to basics". She said "we need to replicate this innovative model to help the farmers in doubling the income by 2022'.

Constraints:

- Agricultural scientist opined that multi location studies are needed to scientifically validate the long term impact and viability of ZBF Model before it is promoted country wide in a large scale.
- Large scale adoption of ZBF may have serious impact on farmers income and food security. Hence a proper scientific validation regarding success of ZBF has to be done. Why **Forward:**
- Few state Governments in our country started supporting this concept . Andhra Pradesh Government has recently announced several plans to assist 3000 farmers to adopt ZBF .
- NITI Aayog is also one of the foremost promoters of ZBF method.
- The Andhra Pradesh Government experience is also being monitored closely to judge the need for further public funding support for ZBF.
- The Indian Council of Agricultural Research is also studying the ZBNF method practiced by basmati and wheat farmers in some parts of India, evaluating the impact on productivity, economics and soil health including soil organic carbon and soil fertility.
- If found to be successful, an Institutional Mechanism is to be created to promote the technology across the farming community.

Though it is the need of the hour to move towards chemical free farming and no doubt ZBF, an environmentally sustainable farming method is the right way to achieve that, enough studies to be conducted to conclusively prove that ZBF is an excellent solution to improve the farmer's income and to achieve food security of the country.

For many years our farmers are involved in natural farming but slowly move towards latest technologies which resulted in improving our country's food security position as well as improvement in farmer's

income. Therefore, necessary trials to be conducted for a reasonable period before implementing methods, which are unproven scientifically

3.4. BIO-FARMIMG

INTRODUCTION:

The bio -farming concept is very old, but its limited knowledge as compare to traditional farming, keep society away from this. The bio -farming efficiently using natural and easily available resources and techniques like green manure, natural waste, crop residues, crop rotation, biological pest control, compost and weed management. Biological farming works hand-in-hand with nature. It balances your soil to produce healthy, pest- and disease-resistant crops while reducing the use of chemicals. When fed to livestock, these crops lead to healthy and productive animals. The impact of bio- farming on natural resources favours connection within the agro ecosystem which is essential for both production and natural preservation.

This farming technique converts traditional management to organic management. Crop production is controlled by cultural and biological means. Bio-farming is modern form of agriculture and combination of science, technology and nature. It include following methods which combine to form bio agriculture: soil management, weed management, livestock, genetic modification, crop diversity, compositing, bio-fertilizers, vermin-compost and other green manure.

PRINCIPLES OF BIO-FARMING:

1. Pollution free environment and resilient to climate change:
2. Maintain fertility of soil:
3. Plant diversity by using green manure crops and tight rotations:
4. High nutritional value of food:
5. Healthy environment for sustainable agriculture:
6. Produce required quantity of food with good quality
7. No toxic spray, free from chemical pesticides and fertilizers

geneticliteracyproject.org.

8. Uses organic materials and the balance of soil, air and water.

9. Biological pest control, compost and weed management.

10. To allow each person who involved in bio-farming production and processing a quality life which meets their basic needs.

IMPORTANCE / BENEFITS OF BIO-FARMING:

• It is eco- friendly and maintaining ecological balance:

• Bio farming helps in conserving natural resources:

• It produces good quality products with less input cost:

• It increases the soil fertility and its texture:

• It easily cops up with adverse effect of climate change and reduces risk of crop:

• It minimize the contamination of food products

• It induces self-protection mechanism in the plant

• It reduces the water requirement of the plant.

bio- farming system sorts out soil erosion which is one of the major problems in various agricultural zones.

This economic farming process minimizing the crop failure

Bio-farming methods deliver agronomic and environmental profits through structural changes and tactical management of farming system

- soil stabilization,
- waste recycling,
- carbon sequestration,
- nutrient cycling, predation,
- Pollination and habitats.

Conclusions

The bio –farming provides several avenues to the farmers through which they generate more income and higher status in the society. It resulted in better performance per unit area as compared to conventional farming. However, managements involved in biofarming confer good prospects to improve soil fertility and minimize soil degradation with the help of natural resource conservation and bio agents. The Bio- farming has made a lot of impact in India during last few years, but lack of sector specific policy of the government and research institutions which help in strengthening its position in farm society and spreading knowhow across the country, therefore an improvement in policy making issues can further strengthen the country's economy too.

3.5. MIX CROPPING PATTERN

INTRODUCTION:

Mixed cropping, including intercropping, is the oldest form of systemized agricultural production and involves the growing of two or more species or cultivars of the same species simultaneously in the same field. However, mixed cropping has been little by little replaced by sole crop systems, especially in developed countries. Some of the advantages of mixed cropping are, for example, resource use efficiency and yield stability, but there are also several challenges, such as weed management and competition. The boreal-nemoral region lies within the region 55 to 70°N. In this area, for example in Finland, the length of the thermal growing season varies from >105 to over 185 days. Typically, variation between locations and years is marked. However, during the year, there can be a wide range of temperature extremes between −70 and +30°C. The majority of cropping systems in this region are usually monocultures, except for forage grass mixtures.

https://www.quora.com/

The possibility of having several crops in a mixture is very challenging in the region due to the short growing season and extreme cold temperatures, meaning that crop earliness and overwintering capacity are a considerable restriction for year-round mixed cropping. A further restriction is the quality requirements set by the industry. Our review will explore a range of mixed cropping possibilities for the boreal-nemoral region, including different possible combinations of spring, winter, perennial, biennial, catch, and cover crops. The reviewed mixed cropping systems could considerably improve the sustainability and efficiency of crop production.

DEFINITIONS:

"When two or more crops are grown on the same land simultaneously, it is known as mixed cropping."

"Mix-cropping is the practice of growing more than one crop on the same field at the same time in a definite row pattern."

As per the above definitions minimum two or more crops grown on same piece of land For e.g., growing wheat and gram on the same land at the

same time is mixed cropping. This practice minimizes the risk of failure of one of the crops and insures against crop failure due to abnormal weather conditions.

The crops to be grown together should have a different maturation time and different water requirements. One tall and one dwarf crop should be grown together. The nutrients required by one crop should be less than those required by the other. One crop should have deep roots, others should be shallow. All these criteria lead to a successful mixed cropping pattern.

Advantages of Mixed Cropping

Mixed Cropping can give many benefits including enhanced yield, nutrient use efficiency, stability, abiotic and biotic stress resilience and enhancing biodiversity.

Advantages

- **The crop yield increases**: This cropping system helps farmers to double their crop productivity and income. Resource use efficiency and yield stability, but there are also several challenges, such as weed management and competition.
- **The pest infestation is minimized**: Mixed species cropping has been shown to be an effective disease management tool, especially in cereals. Reduce the attractants that invited the infestation or the increase in pest numbers Reduce the attractants that invited the infestation or the increase in pest numbers.
- **Reduction in the risk of crop failure**: mixed cropping systems could considerably improve the sustainability and efficiency of crop production.
- **The soil is utilized properly**: Farmers can keep their fields under continuous production. More than one variety of crops can be harvested at the same time.
- **Increases productivity per unit area:** Intercropping is the practice of growing more than one crop on the same field at the same time in a definite row pattern. After one row of the main crop, three rows of intercrops can be grown. This increases productivity per unit area.
- **Reduction in cost:** Reduction in the overall cost of input decreases, cost spent on fertilizers, irrigation, labour, etc. reduces because of growing two or more than two crops on the same field**.**
- **Better farm management:** This results in better farm management and increased income of the farmer. Although only 5% of global rain fed cropland is under multiple cropping, whereas 40% of global irrigated cropland is under multiple cropping.

3.6. SUMMERY

Agro-ecology is an integrated approach that applies ecological and social concepts to the design and management of food and agricultural systems. Agro-ecology has some common principles and basic approaches that rely on nature's wonderful and complex processes and products. Zero budget faming, Bio-farming or organic framing are the methods to maintain ecological balance, it means agro-ecology, which is essential to sustain agricultural sector.

3.7. EXERCISE

Q.1. Write the meaning of Zero budget faming. State its importance in context of India.
Q.2. Write the definition of Bio-farming with its various advantages.
Q.3. Write detail note on the relation between ecology and bio farming.
Q.4. Elaborate the importance of mix cropping pattern in farming.

4

HORTICULTURE - I

Unit Structure:

4.1. Objectives

4.2. Introduction

4.3. Horticulture

4.4. Scope of fruit production

4.5. Climatic zones and horticultural crops

4.6. Selection of site

4.7. Wind Breaks

4.8. Shelter Belts

4.9. Preparation of Layout for Orchard Management

4.10. Questions for self-study

4.1. OBJECTIVES

1) To study the scope of horticultural crops
2) To know the factors helpful for horticulture
3) To study the climatic zones and the fruits grown
4) To know how to prepare a plan layout for orchard management.

4.2. INTRODUCTION

Horticulture is a branch of agriculture, dealing with the art, science, technology and business of growing plants, which includes cultivation of medicinal plants, fruits, vegetables, nuts, seeds, herbs, sprouts, mushrooms, algae, flowers, seaweeds and non- food crops such as grass and ornamental trees and plants. Conservation of plants, restoration of landscapes, designing of landscape and garden, construction and maintenance, and arboriculture are also included in this. Horticulture even refers tothe growing of plants in a field or garden.

hindriseorg.

Horticulturists apply their knowledge, skills, and technologies to grow intensively produced plants for human food and non-food uses and for personal or social needs. The work of horticulturists involves plant propagation and cultivation with the aim of improving plant growth, yields, quality, nutritional value and resistance to insects, diseases, and environmental stresses. Horticulturists work as gardeners, growers, therapists, designers, and technical advisors in the food and non-food sectors of horticulture.

Over the years, horticulture has emerged as one of thepotential agricultural enterprise in accelerating the growth of Indian economy. It is playing an important role in the country's nutritional security, poverty alleviation and employment generation program. Itoffers a wide range of options to the farmers for crop diversification and also provides ample scope for sustaining large number ofAgro-Industries generating a huge employment opportunities.

Earlier plan periods focused attention on horticultural research and development. As a result India emerged as a leading player in the global scenario. India has emerged as the world's largest producer of coconut and tea and the second largest producer and exporter of tea, coffee, cashew, spices, and exports of fresh and processed fruits, vegetables, cut flowers, dried flowers is on the increase.

Horticulture in India has become a sustainable and viable venture for the small and marginal farmer, because of thoughtful research, technological and policy initiatives and inputs farmer's food consumption levels and household income has increased.There is great scope for the horticultural industry to grow andflourish as this sector has attracted entrepreneurs for taking up horticulture as a commercial venture.

4.3. HORTICULTURE

Horticulture is broadly defined as the science and art of growing fruits, vegetables and flowers and crops like spices, condiments and other plantation crops. It is the science of cultivation of garden plants. The word horticulture is derived from the Latin word Hortus which means enclosure (garden) culture i.e. cultivation. Thus in short we can say horticulture means culture or cultivation of garden crop.

Horticulture science is the most distinct branch of agricultural sciences. It is divided into four different branches:

(A) Main Branches –

Pomology, Olericulture, Floriculture, Fruits and Vegetable Preservation are the main branches. Pomology branch deals with the cultivation of fruit crops. Olericulture deals with the cultivation of vegetable crops. Floriculture deals with the cultivation of ornamental flowers and land scaping. Fruits and Vegetable Preservation deals with the principles of fruit and vegetable preservation.

(B) Sub Branches - Plantation and medicinal plants, Ornamental Gardening, Landscaping grading and Nursery plant production.

Importance of Fruit Growing

Since long back fruit growing has been practiced in India. The art and science of horticulture has now developed into one of the most skillful and intensive form of land utilization. Fruit growing is now one of the important and paying branches of horticulture. The fruit production and per capita conservation of fruits lets you know the standard of living of the people in the country. There are many economic advantages of fruit growing.

They are as follows-

1) Per Unit Yields are High- We get best returns than many of the field crops from the well maintained and established orchards. More yield and income is generated than any of the agronomic crops from a unit area of land. For example- the average yields of papaya and banana are 10 to 15 times more than of agronomical crops.

2) High Net Profits- The initial investment for the establishment of an orchard is high. But it is compensated by high productivity or else due to high value of produce. For example the cashew nut – average yield per tree is less but due to its market value it fetches higher economic returns.

Fruit farming a source of Raw Material for the Agro Based Industries:

Fruit farming provides raw material for various agro-based industries like preservation of fresh fruits and canning.

1) Efficient Utilization of Resources: Farmers have to engage themselves in other occupations during slack season, as agronomic crops are seasonal in nature. The farmer is busy or is engaged throughout the year in farm operations as fruit growing is an perennial occupation in nature. He can fully utilize the resources and assets like machinery in farm, land and water for production purpose throughout the year.

2) Utilization of Waste and Barren Lands for Production:

Most of the fruit crops need perennial and good soil for taking the production. But there are also many other fruit crops that are hardy in nature like mango, ber, cashew, custard apple, apple, jamun etc. that grow on poor, shallow, undulated soils which are considered to be unsuitable for growing grain or agronomical crops. Traditional farming have proved uneconomical on waste-lands. But mango and cashew plantations on hill slopes in konkan have proved to be successful and have brought additional income to the growers.

3) Ability of Earning Foreign Exchange:

Export of many fresh fruits and processed products and spices have enabled the country to earn a good amount of foreign exchange.

a) One Time Capital Investment:

As most of the fruit crops are perennial in nature, there is no recurring expenditure of planting and layout of a fruit orchard.

b) Continuous Flow of Money:

Most of the fruit harvested are perennial in nature and are highly perishable. So they need to be marketed immediately after harvest, which provides a source of continuous flow of inputs and for other expenses of immediate nature while agronomic crops are harvested in specific seasons only.

i) Fruit growing in kitchen gardens help to reduce the familybudget on purchase of fruits.

ii) Fruit tree farming reduces soil erosion, silting tanks and airpollution.

iii) Planting trees help to maintain ecological balance and increase the precipitation of the locality.

iv) Fruit tree farming is highly intensive and skillful enterprise, generate employment even for trained persons.

4.4. SCOPE OF FRUIT PRODUCTION

1) Need to Increase Production to Meet Dietary Requirements:

In India fruit consumption per capita is very low compared to other countries. The reason is that only a very small fraction of the total cropped area is under fruits crops. The fruit production in India has to be increased to the level at which both rich and poor can afford to buy it. The prices of fruits are very high that the fresh fruits are out of reach of large population. With efficient production and marketing, the price could be reduced to increase consumption of fruits and also give good profit to the grower.

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2) Increasing Irrigation facilities in Maharashtra:

Most of the commercial fruit trees require perennial irrigation. By exploiting all the resources the maximum area that can be brought under irrigation would be 25% of the total cropped area. There is still vast scope to increase irrigated area and help to increase area under fruit crops as the government is giving priorities to such works.

3) Scope for Increasing Area under Dry Land Fruits:

All the fruits do not require perennial irrigation there are some fruits like ber, custard apple, cashew nut etc. hardy in nature and can grow under rain fed region. In Maharashtra around 35lakh hectare land is available for rain fed horticulture. There is good scope to use this land for fruit crops.

4) Increasing Urbanization and Change of Food Habits:

Due to industrial growth and increased urbanization demand for fruits also has increased. Change in food habits due to education and assured income is also the reason for increased demand for fruits.

5) Increased Transport Facilities:

Most of the fruits have less storage life and are highly perishable, so they need quick disposal immediately after harvest. As the transport and communication facilities have developed quick transport by road, rail and air enables the farmers to transport fruits to long distance markets in short time and in good condition. Increasing transport facilities provides great scope for fruit farming.

6) Increase in the Cold Storage Facilities and Pre-Chilling Centre:

Fruits are highly perishable and have less shelf life. The market gluts reduce the prices of fruits during the peak harvest periods. Cold storage facilities help in regulating the market supply and stabilize the rates of fruits, and also pre cooling after harvest helps to extend shelf life. Government of Maharashtra and other agencies provide funds to develop these facilities in production centers, so as to increase more area under fruit in the coming years.

7) Scope for Agro-Based Industries:

Even though after industrial development in the country we depend on the agricultural sectors for employment. So more and more agro-based industries are to be set up to keep our economy on sound footing. There is potential to develop agro-based industries like canning and preservation from fruit farming besides sugarcane.

8) Development of New Techniques:

Special horticultural practices like ringing, girdling, notching, bahar treatment, high density planting etc. and use of growth regulators, grafting, drip irrigation and tissue culture have helped to increase the productivity in fruit crops and bring more land under horticulture cultivation.

9) Evaluation of New High Yielding Varieties and Introduction of New Crops:

Development of new high yielding varieties of fruits like pomegranate, guava, mango, grapes, cashew nut have led to bring more area under fruits along with the commercial cultivation of the ber, anola etc.

10) Availability of Loan Facilities:

Lack of capital was a major hurdle in the expansion of area under fruit crops as fruit crop is capital intensive. But today there are many co-operative and commercial banks providing finance for fruit farming.

11) Government Initiative:

Government of Maharashtra had started a very ambitious program of fruit crops development in which a 100% subsidy is given to marginal farmers and for reserved categories and 70% subsidy for others on the establishment and maintenance of orchards for a period of 3 years. This led to an increase in the area under fruit crops cultivation.

12) Scope for Export of fruits:

Indian fruits like mango, grapes, banana, pomegranate, citrus, ber, and cashew have a good market in the European and gulf countries. As a result the exports are on the increase.

Availability of cheap labor, very high production of fruits and suitability of climate for fruits are also other factors for the increase in the fruit crops.

4.5. CLIMATIC ZONES OF HORTICULTURAL CROPS

One of the important complex factors influencing fruit production is the climate, which includes basic environmental conditions like temperature, rainfall, humidity and light. Fruit growing zones are based on these climatic factors. They are divided into Tropical, Sub-Tropical, Temperate

and Arid Zone. There are certain exceptions to this. For example- grapes can be grown in temperate and sub-tropical regions, while papaya can be grown in tropical and sub-tropical condition.

A) Temperate Fruits:

Fruits belonging to this class grow efficiently in cold regions where temperature falls below freezing point during winters. During winter, the trees shed their leaves and go in the resting period. A definite chilling period is required to break this rest period. Fruits growing in the temperate regions are apple, pear, walnut, almond, plum, peaches, strawberry etc.

B) Tropical fruits:

Tropical fruits require hot and humid climate in summer and mild winter. These fruits are unable to endure cool temperature.

The fruits included in this class are mango, sapota, papaya, cashew, pineapple, banana etc.

C) Sub-Tropical Fruits:

The fruit crops in this class are intermediate in character to tropical and temperate regions. They grow mostly on the plains where the climate is hot, comparatively dry and very mild winter. The fruits in this class are citrus, phalsa, fig, guava andpomegranate.

D) Arid Fruit Crops:

The arid region has extreme climatic conditions. In this region rain is very low and its distribution is erratic leading to low plant standard and productivity. The water storage capacity of soil in this area is very low. Soil is poorly textured, shallow and has highevaporative losses.

The arid fruit crops can be grouped in two categories:

1) The fruits in this category have deep rooted roots, are short flowering, and fruit set on the commitment of the monsoon. Complete development of fruit is while the soil is moist. Fruit grown are custard apple, ber, tamarind, anola etc.

2) Flowering of this fruit starts after rainy season and harvesting during summer season. Such crops are very handy. Fruits in this group are mango, jamun, phalsa, wood apple, charoli, cashew nut, jackfruit, kokum, karvanda, mulberry, etc.

4.6. SELECTION OF SITE

Selection of site is important in fruit industry as the fruit plants are planted permanently and if any mistakes committed on the onset are difficult to rectify at the later stage. Investment in the orchard is a long-term investment and requires careful planning and organization. Many growers who set up orchards without proper planning, has to repent later.

Mistakes made in the initial stage like the selection of location site, planning distance, soil, climate, irrigation facilities, varieties, nursery and nursery plant material used considerably reduces the returns on investment done in an orchard. The failure of orchards not only results in the loss of capital and wastage of long range efforts of the growers but also proves detrimental to the spread of gardening in the locality. This makes other fruit growers apprehensive and difficult to invest their money in long-term enterprises like fruit growing. It is therefore essential to seek guidance from an experienced fruit grower before starting the business in horticulture.

Factors to be considered while selecting the site for FruitCrops-

1) Climate and Soil:

The main natural factors on which the success or failure of the fruit growing depends are climate and soil. As a fruit cannot be grown in any type of soil and every type of climate the fruit grower should have the knowledge of the effect of various soil and climatic conditions on fruit growing. Factors responsible for climates are temperature, rain, atmosphere, humidity, wind, and hails, light. Soil has factors like physical condition of the soil and its fertility, nature of sub-soil, its drainage condition, temperature texture and itsconsumption.

2) Transport Facilities:

The site selected should be nearer to a co-operative marketing center and should be connected by a good road or railway, that will reduce the transportation costs, as most of the fruits are perishable, so quick transport to the market without wasting much time is important.

3) Irrigation Facilities:

Irrigation facilities should be adequate and all the year round. Water supply should be abundant and be available at a reasonable price, or else the cost of production will be increased. Again the water should be free from impurities.

4) Cheap Man Power:

Availability of large no of labor should be taken into consideration while selecting the site. Cost of production can be kept down if there is availability of cheap labor.

5) Owner's House:

For easy and effective supervision the owner should havehis home in his orchard. So the availability of medical, educational and social amenities in the vicinity of the site should also be considered.

6) Market:

There should be a good demand for the variety of crops selected. Therefore market facilities should be available in the nearby area of the site selected.

7) The site should not be close to any diseased plantation or elsemust be isolated from old plantation.

8) The selected site should be free from cyclones, frost, hails, storms, strong and hot winds.

After selecting a site clear the land of all vegetation including shrubs, bushes and standing local trees. Plough the land deep bothways and level the land if it is uneven. The leveling of land may involve shifting of major soil layers. To improve the physical and chemical composition of soil green manuring crop should be grown and crushed by ploughing operation before it starts flowering.

To protect the fruit trees from stray cattle and other animals fencing should be done before planting fruit trees. Though initial cost is high barbed wire fencing is very good. While the temporary fencing requires frequent replacement and repair. Some times live fence also is used and the plants used as live fence are julifora, corrisa, caronda (karvanda) or claespiniasepiara (chillary) and can be planted at the onset of monsoon.

4.7. WIND BREAKS

Planting of tall growing trees all-round the orchard is called windbreaks. Fruit orchards bear heavy losses when exposed to strong wind. Loss of moisture by transpiration and surface evaporation is heavy due to strong winds. Strong winds cause damage to the fruit trees by breaking of branches, destruction of blooms, dropping of immature fruit and erosion of surface soil. Fruit production in the exposed orchard is reduced due to drying of a stigmatic fluid yield and also due to reduced activities of pollination by the insects. The protected orchard growth and yield is high as compared to the exposed orchard. It is therefore necessary to planttall trees as windbreaks to protect the orchard.

Selection of Wind Breaks:

The Wind Break should be erect and tall growing, hardy and drought resistant and occupy less space. The trees should bemechanically strong and dense to resist maximum wind. So while selecting windbreaks more emphasis should be given to the height than to thickness. They will give full protection covering a distance of 4-5 times the height of trees and partial protection for some distance where there is leveled land.

Planting and Spacing of Wind Breaks:

Wind Breaks are planted at least two years after planting fruit trees. They are planted in rows. The first row of it is planted 40 feet away from fruit plants. One to two rows of such trees are planted on the west and south side of the orchard at a closespacing of 12/12 or 12/15 feet to form thick screen.

Precaution after planting of Wind Breaks:

Wind Break trees may sometimes compete with the fruit trees for water and nutrient. So to prevent this trench should be dug about 3 feet deep and 20 feet away from the row of wind break trees and all the roots of windbreak trees are exposed and are cut off from reach to the fruit trees.

Species used as Wind Breaks:

The trees commonly used as wind break are as follows: Polyithialangifolia, casurinaequsitifolia, erythrinaindica, eucalyptus clirddors, gravillarobustus, dalbergiasisso, syzgium cumin, mangiferaindica, averhoacarambola, bambusa species.

To stop soil erosion by wind the wind break trees used are eryhinaindica, bionomiamegaputomica, millingtioniahortensis, cassia pungent etc.

Banana, Papaya and Beetle Vine orchard are protected by sysabenia species.

Advantages of Wind Breaks:

1) Reduces wind velocity.
2) Prevents the damage caused by cold wind and frost.
3) Checks evaporation losses of water from the soil surface.
4) Increases fruit production.

4.8. SHELTER BELTS

Shelter Belt is a belt of trees or shrubs maintained for the purpose of shelter from wind, sun and snow. It is a wide range of trees, shrubs and grasses planted in rows right across the land at right angles to the direction prevailing to reduce wind velocity and to give general protection to the cultivated area, to prevent soil erosion and to decrease the effect of hot winds.

Shape and Composition of shelter belts:

A typical shelter belt has triangular cross section. This is done by planting tall trees in the center, flanked on both sides successfully on other trees, tall shrubs and then low spreading shrubs and grasses. There should be a systematic mixture of trees, shrubs and grasses keeping in view their usefulness, height, shape, crown form, longitivity and resistance to insects and pests.

Density of Width:

A certain amount of penetrability is desired in shelter belts. It is seen that though solid walls provide considerable protection the effect disappears after a short distance and there is great fluctuation. But in partially

penetrable shelter belt zone the influence is greater and velocity curve shows a smooth and slow declining trend, which is more effective. This partially penetrable belt is created, by planting trees and shrubs adequately in rows. The shrubs should be planted 1 to 1.5m apart and trees 2 to 5m apart inrows. The width of shelter belts depend on the climatic conditions, wind velocity and the type of soil.

Orientation:

The orientation of shelter belt depends upon the wind direction and velocity, particularly during the vulnerable season. Shelter belt should be oriented as early as possible at right angles to the prevailing wind or to the winds that are more damaging at theprevailing time of the year. Wherever winds blow from different directions shelter belt should be raised in quadrangles.

Height and Spacing:

Height of the shelter belt is more important. It affects the distance to which protection will be given on the leeward side. If the trees forming shelter belt are higher, more beneficial effect on the leeward side. Shelter belt protects the area upto 15 to 20 times the height.

Choice of species:

The trees to be planted for shelter belt are selected on the basis of climate, soil and topography of the area. Local species should be preferred for plantation, as they adjust easily. The species selected should be fast growing, draught resistant and to keep the animals away from the orchard.

Species recommended for shrubs are calotropica, procers, crotolonia, brubia, cailigoman, polygonides, clear adendronphymodes, cassia craicaulum, dedonaevisosa, jutrophacurcas, sysabenia aculeate.

Species recommended for small trees are acacia, jacyumental, acacia lecucophillea, saydoraoleodes.

Trees species recommended are Acacia Arabica, A senggal, Albrizza Labback, A Ordirchata, Dalbergia Sisso, Lannea Coromendoice, prospopisjulifora, Progemia Pinnata, Eucalyptus sp.

Advantages of shelter belts:

1) It reduces wind velocity and erosion of soil from the orchard.
2) It retards the evaporation process.
3) It can increase the humidity up to 50% as it reduces the faster rate of evaporation from soil and crops. As result moisture is retained due to the reduced movement of air.
4) It increases soil moisture.
5) It can increase or decrease the temperature.
6) It increases the fruit production by minimizing the damage by wind.

4.9. PREPARATION OF LAYOUT FOR ORCHARD MANAGEMENT

It is advisable to prepare a sketch plan on paper before actually planting the trees. It will enable the farmer to provide for a most economic orchard management. The farmer also can show the economic layout and location of roads, drainage system, irrigation channels, hedge, wind breaks, etc. in the plan.

1) Roads and building:

The owner's residence and layout quarters should be locatedfairly close to a public road or in the center of site or near the water source in the site. The area necessary for construction should be left unplanted even though the construction is delayed. Straight roads of 8 feet to 10 feet at right angles to each other should be constructed. This is for easy movement and to carry garden machinery. The roads should have gentle slopes on either side of the road to drain off excess rainwater.

2) Position of Well:

The wells should be dug before planting trees if it is a sourceof irrigation because the trees would require water as soon as they are planted. The well should be located and dug at the highest point to facilitate easy distribution of water by gravity at minimum costs.

3) Fencing:

To prevent destruction of trees from stray cattle and protection from thieves the orchard should be fenced from all sides before planting the trees. Fencing of thorny bushes requires frequent repairs and replacements, so barbed wire fencing is agood option but its initial cost is too high. The best option is to build a live fence, which needs no initial investment except watering and maintenance during summer months. Some of the thorny plants like prosophusjulifora, chillan, etc. make a very good live fence.

4) Wind Breaks:

Exposures of orchard to wind increase the losses of moisture by transpiration and surface evaporation. Strong winds cause damage by blowing off branches and fruits. To reduce the damage, a wind break is necessary for every orchard. The trees commonly used as wind breaks are eucalyptus, casurina, jambul and mango trees for crops with low height like banana or papaya. Windbreak of shewari is grown on southern and western sides of the plantation.

5) Shorter fruit trees be planted in the fore-ground and taller treesfurther away to facilitate better watching at the orchard.

6) Fruit trees requiring water should be planted near the water source while the ones depending on rain are planted away from it.

7) High fertile area of the orchard should be used for costly fruit crops.

8) Fruits that ripen at the same time should be planted in a good conditioned compact block.

4.10.QUESTIONS FOR SELF-STUDY :

1) What is the importance of horticulture and give the importance of fruit growing?
2) Explain- The scope of fruit production.
3) What are the different climatic zones of horticultural crops?
4) How the selection of is site important and give its factors?
5) What are windbreaks? Explain in detail.
6) Explain in detail the shelterbelts.
7) What are the different steps in the preparation of layout for Orchard management?

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5

HORTICULTURE - II

Unit Structure:

5.1. Planning an Orchard

5.2. Different Methods of Planning Orchard

5.3. Planting and selection of plants for Orchard

5.4. Propagation Methods in plants

5.5. Questions

5.1. PLANNING AN ORCHARD:

A careful plan of orchard should be prepared.

a) Planning of an orchard helps in making it most economic and can be managed efficiently.

b) It is necessary for economic layout and location of roads, drains, irrigation channels, path, hedge and wind breaks. Knowledge of following points is a must while preparing plan for a big orchard.

1) Building of the owner should be at the center or at high level for proper supervision.

2) Plant fruits plants according to their soil requirements.

3) Optimum spacing is kept to give maximum number trees per hectare.

4) Irrigated trees should be planted near the water source.

5) Do not mix large trees in small trees.

6) Big trees should be planted at the back and small trees should be in front.

7) Evergreen trees should be in front and deciduous trees should be behind.

8) Trees requiring spacing should be grouped in one block.

9) Pollination should be provided to self-compatible fruit trees e.g. mango, ber, etc.

10) Watchman's shed should be close, to protect the fruit crop production from beggars, thieves and animals.

5.2. DIFFERENT METHODS OF PLANNING ORCHARD:

Different methods of planning an orchard are Square, Rectangular, Hexagonal, Triangular, Diagonal, Contour.

a) Square system:

In this system of plantation a tree is planted on each corner of a square no matter the planting distance. This plan is commonly used, as it is easy to layout. In this system inter cropping and cultivation is visible in two directions, for e.g. mango, banana, and citrus crops.

b) Rectangular System:

This system is similar to that of square system. Except in this system row to row and plant to plant spacing is not the same. For e.g. grapes.

c) Hexagonal System:

In this system the trees are planted at each corner of equilateraltriangle. In this way six trees at the corners and one tree in the center are planted. The trees are spaced equally from each other, so inter cultivation or cropping is difficult in this system.

d) Triangular System:

In this system the trees are planted as in the square system but are planted in alternate rows i.e. in the 2^{nd}, 4^{th}, 6^{th} and other alternate rows. This system gives more space for the trees and intercrops which we do not have in square system. It is difficult for layout cultivation.

e) Diagonal System:

It differs from other system of planting trees. In this system an additional tree is planted in the center of each square of planted trees. The central tree is usually used as filler, which is planted for a short period. In this system of layout the plant production isdoubled than the square system of planting. For e.g. mango+papaya + mango + fig

f) Contour System:

This system is followed on hills with high slopes. The tree rows are planted along a uniform slope and usually at right angles to the slope. The main intention is to reduce the loss of top soil due to erosion.

5.3. PLANTING AND SELECTION OF PLANTS FOR ORCHARD

Planting:

After planning and preparing a layout of an orchard planting is carried out. Before planting pits are dugged out at required spacing. Then they are

filled with F.Y.M leaf mold, fertilizer. While planting the bugged and grafted trees joint should be inside the pitsor covered with wet soil or else it will be infected at the bud joint. Stagnation of water should not be there in the pits during rainy season. During summer young plants must be protected from heavy sunshine. For the proper growth of plants regular management practices should be followed.

Selection of plants:

It is necessary to select a plant carefully. While selecting it should be seen that it should be of good parentage, should have been propagated on right root stock, should be free from pests and diseases, should have a healthy bark, should have a robust and vigorous look and the bud or graft joint of medium sized plant with healthy and normal growth with well-placed branches all round is the best. The age of trees at planting is also important. Older plantsare not preferable. Plants selected should be within one year of grafting or budding and one year old plant with a height of 2 to3 feetis to be selected.

High Density Planting:

Increasing the plant population per unit area for increasing the production of fruit crops is called high density planting.

Advantages of high density planting:

1) Best utilization of land and resources.
2) Increase in the yield per unit area.
3) Easy for inter culturing operations, plant protection and harvesting.
4) Quality production of fruit crops.
5) To obtain export quality of the harvest.

Disadvantages:

1) The life span of fruits is very less.
2) It is difficult to manage the tree canopy.
3) Require high techniques for the maintenance of fruit trees.

5.4. PROPAGATION METHODS IN PLANTS

Plant propagation is defined as " Controlled reproduction of a plant by man in order to perpetuate a selected individual, or groupof individuals which is having specific value to him."

There are two methods of propagation: A) Sexual Reproduction and B) Asexual Reproduction

A) Sexual Propagation in plants - Multiplication of plants by using seed is called as sexual propagation.

Advantages-

1) The plant raised by seed is planted live.

2) These plants are hardy and deeply rooted. So their growth is vigorous.

3) There is a possibility to obtain a change in the seedling, the performance of those are better than their parents. For e.g. variety of mango Alphonso, Dasharia.

4) The poly embryonic phenomena- In this phenomena propagation of more than one seedling from single seed produce true to type, nuclear embryonic seedling which could be used as rootstock for uniform performance. E.g. Mango varieties color and bappakal. It is also common in jamun and citrus trees.

5) Seed propagation is necessary when vegetative propagation is unsuccessful or expensive. E.g. papaya, coconut and areca nut.

6) Exploitation of hybrid is possible only when the hybrids aremultiplied in the first instance through sexual propagation although subsequent fixing of heterocyst is effected through vegetative propagation. E.g. sapota (cricket ball x oval) and ratna mango (alphanso & neelam).

7) Roots stock is generally raised by seed. E.g. rangpur lime and jamberi for citrus.

8) Seed propagation is the only method when seedling are required in large numbers. E.g. dry land fruit and forest species.

Disadvantages:

1) Choice tree or any hybrid tree cannot be perpetuated true totype of seed. (except in Apomixes)

2) When Progenies are not true type, they become inferior because in the commercial orchard, it is necessary to have uniform quality, growth and yielding capacities.

3) Seedling has along juvenile period. In crops like citrus, cocoa and rubber the seeds must be sown afresh i.e. immediately afterextraction. Many varieties are seedless.

4) Seeds lose its viability in short period.

5.4.1. Seed Germination and Seed Propagation: Seed propagation is necessary in the following cases-

i) Where vegetative propagation is unsuccessful, difficult or expensive.

ii) It is necessary for raising rootstock for grafting and budding.

E.g. rangpur lime and jamberi for citrus, khirni for sapota.

In all such cases rootstock plants have to be raised mostly through seeds.

Seed Formation and Maturity:

Seeds develop along with the fruits. Fruit reaches full size and maturity, when the fruit ripens. Hence seed should be extractedonly from ripe fruit. Seeds gathered from immature fruit may not germinate under favorable conditions and may loose viability morequickly than fully matured seeds.

Seed Storing:

Normally seeds should be stored in relatively dry condition at low temperature. Some seeds should be sown immediately after extraction. Others must be kept for some time depending on the type of plant. Most of the plant seeds retain their viability for alonger period when stored at a relatively low temperature than high temperature. So store the seeds in cool and dry place. If somehow exposed to damp atmosphere, even though after thorough drying seeds absorb moisture and rapidly deteriorate. Some seeds are to be kept moist and exposed to cold or freezing temperature known as stratification –to ripen after dormant and to modify seed coverings.

Dormancy:

This term is used to describe a seed that will not germinate in any condition associated either with the seed itself or with existing environmental factors such as temperature and moisture. Some seeds may even germinate inside the fruit. For e.g. jackfruit, avocado, papaya. It is called as viviparous germination.

Best period of germination:

Some seeds do not germinate immediately after harvest even in the favorable conditions. This is due to physiological conditions. This is because the seeds are in the resting period after ripening period.

Seed Viability and Longevity:

Seed viability means the presence of life in the seed and longevity means the length of time the seeds will retain their viability. Some seeds like citrus seeds are short lived.

5.4.2. Pre-germination Seed Treatment:

1) Chemical (Acid Scarification):

The aim behind soaking seed in concentrated sulphuric acid is an effective method to modify hard or impermeable seed covering. Depending on the species the time of treatment may vary from 10 minutes to 6 hours. The seeds are thoroughly washed in clean water after the treatment to make

them free from acid and are then again sown immediately. The seeds of cotton, ber, asparagus are treated with 50% concentrated sulphuric acid for 3 to 5 minutes.

2) Mechanical (Scarification):

Seeds of a few species have impermeable seed coat. The hard seed coat can be rendered permeable to water and gases. Their germination is greatly improved by mechanical scarification by taking care that the seeds are not injured. This can be achievedby –

a) Placing the seeds between two sand papers, one stationed andother revolving.

b) Passing seeds through the machine that scratches the surfaceof the seed.

c) Filling and notching to make the seed coat permeable to water.

d) Using a hammer.

3) Seedling (Boiled Water Treatment):

Pouring boiling water over the seeds and let it to be cooled gradually about 12 to 15 hours to soften dry and hard shelled seeds. E.g. coffee, chicku, canna, babul.Chillar etc. this will hasten the process of germination.

4) Soaking in water:

To modify hard seed coats, to remove inhibitors, to soften seed and to reduce the time of germination seeds are soaked in water. The time of soaking seeds in cold water depends on the hardness of the seed coat. E.g. gulmohar, peas, beans cassia tree seeds, etc.

5) Stratification (Moist Chilling):

To bring about prompt and uniform germination seeds of woody trees or shrubs are exposed to low temperature. Stratification has some benefits in softening the seed coats. In this method the seeds are arranged in alternate layers of sand in shallow boxes for pits or trenches. This helps in rapid germinationof seeds. For e.g. peach, cherry, plum, oats, grapes, etc.

B) Asexual Propagation in Plants-

Asexual propagation or Vegetative Propagation is the multiplication or perpetuation of any plant from any vegetative part as plant other than seed.

Advantages of Vegetative Propagation:

1) The progenies are of true type like that of the mother plant.

2) Vegetative propagation is used where no seed is formed or germination of seed is very slow or no productive seed is formed. In

these cases there is no other alternative than vegetative propagation. For e.g. banana, pine, apple and roses, seedless grapes.

3) Some rootstocks have the capacity to resist or tolerate the adverse environment factors such as frost and adverse soil factors like salinity or alkalinity. E.g. frost resistant- foncirus trifoliate (Trifoliate orange) Rangpur lime.

4) The ability of certain rootstock to resist pest and diseases can be advantageous. An apple when grafted on rootstock like merton 778, 793 is resistant to wholly aphid.

5) The plans propagated by vegetative method are generally dwarf in nature than the seedlings. Dwarf trees facilitate pruning, spraying and harvesting easy on the seedling. As a result more number of plants can be planted in a unit area.

6) It is undesirable to replant an existing tree either with reference to its quality or susceptibility to pests and diseases. This defect can be overcome easily by vegetative propagation through grafting or budding of desirable scion to the existence tree by working techniques.

7) Many plants are propagated by vegetative methods because of speedy multiplication.

8) Novelty can be developed by grafting or budding many varieties on single plant. E.g. roses.

9) This is advantageous to convert inferior varieties into superior varieties.

Disadvantages:

1) Plant is not vigorous and long-lived.

2) No new varieties are evolved or can be developed.

3) This method is expensive, laborious and time consuming.

5.4.3.Plant Propagation by Cutting

Cutting is a method of asexual propagation. In this method a portion of any vegetative part such as stem, leaf, root is cut from the parent plant and is placed under favorable environmental condition to form roots and shoots, producing a new independent plant.

A) Stem Cutting:

This is the most important type of cutting and can be divided into three types based on the nature of the wood used in cutting. I) Hard wood cutting, II) Semi-hard wood cutting, III) Soft wood cutting. In propagation by stem cutting, segment of shoots containing lateral or terminal buds are handled under proper condition to develop adventitious roots to form independent plant.

I) Hard wood cuttings:

This method is easy and less expensive. As hard wood cuttings are not readily perishable they can be shifted safely over a long distance if necessary. Usually the cutting is prepared during the dormant season. Wood from the previous season growth is used for hard wood cutting.

II) Semi-hard wood cutting:

The cuttings are prepared from the new shoot just after it has grown a little bit and which is partially matured.

III) Soft wood cutting:

This type of cutting is always made with leaves attached to stem. This type of cutting is made from coleus, pilea, alternanthea, etc. and also from succulent, herbaceous green plants like carnation, potulaces, etc.

B) Leaf cuttings:

In this method the leaf blade, sometimes the petiole is utilized in germinating a new plant. In most cases adventitious roots and shoot develop at the leaf base. Various types of leaf cutting areas follows:

I) Leaf Blade Cuttings:

Two to three pieces of the long tapering leaves are inserted into the sand. After some time a new leaf is seen at the base of the piece. E.g. snake plant.

II) Leaf Vein Cutting:

In this method of cutting a new plant develops from the leaf vein at the base of the leaf piece. E.g. begonia rex.

III) Leaf Margin Cutting:

In this method new plants arise from the foliar embryos in the notches at the leaf margin.

IV) Leaf Bud Cutting:

This method consists of a leaf blade, petiole and a short piece of the stem with the attached axillary bud. For e.g. blackberry,camellia.

C) Root Cuttings:

In root cutting method the period when the plant is growing rapidly root cutting must be avoided. It is very important to maintain the correct polarity when planting the root cuttings. For e.g. guava, pahadi-gulab, India cork tree.

5.4.4. Plant Propagation by Layering

Layering is a form of vegetative propagation where cuttings are made to form adventitious roots while the cutting is still attached to the mother plant. Stems of the mother plant are covered in a growing medium in various ways to exclude light, increase the moisture level, and stimulate root growth. Once the roots are formed the new plant or layer is dug and transplanted to the desired location. This method is used for propagating native species where time or resources may be scarce.

Advantages of layering:

a) Less maintenance.

b) Allows propagation to be performed on site.

c) Natural accumulation of photosynthetic and hormones due to girdling, incision or bending.

d) Many times a large plant is the product.

e) Little investment is required.

f) Major advantage is that it requires less maintenance. As in layering method they are still attached to the mother plant and therefore require less maintenance. Also their supply of water is not decreased because of the attachment to the mother plant. It also eliminates the need for resources and labor intensive practices such as shading o regularly misting of young cuttings. Layering also reduces the need to harden off cuttings before planting since they already are in the native environment.

Disadvantages:

a) It takes long time to produce new plants.

b) This method produces only a few plants per mother. It is not ideal for plants where you want a lot of plants from only a few mothers or sites where resources and time are not particularly inshort supply.

Key to success of Layering:

Layering method can be successful if light is excluded from the rooting section of the stem. If light is allowed to penetrate root formation will not be successful. Girdling, incision, bending or cracking the stem or wounding the stem in some form triggers the release of hormones as a result propagation can be successful.

Root Formation during Layering:

Root formation during layering is stimulated by various stem treatments.

They are as follows:

1) Bending of shoots to a sharp V shape.

2) Giving a cut or incision at the lower surface of the shoot.

3) Girdling-by removing a ring of bark or by wrapping copper wire around stem.

Different methods of Layering:

a) Simple Layering or Tongue Layering:

In simple layering method a branch of the tree is bent to the ground and some portion of it is covered by soil. The terminal end of the branch is exposed. Root initiation takes place at the portion that is buried. After allowing sufficient time to grow the layer isseparated from the mother plant by cutting the layered shoot. For e.g. guava, jasmine, etc.

b) Compound Layering:

This method is the same as simple layering. But in thismethod the branch is alternately covered and exposed along length. The branch selected for compound layering should be long, so that it can be layered at different places to branch. This method is mostly followed for creepers.

c) Serpentine Layering;

It is like compound layering except that individual nodes are covered with media. Usually there is an alternation where every second node is covered. This method is most effective with plants that yield flexible shoots.

d) Air Layering:

This technique is performed without placing the layered branch or shoot below the soil line of the mother plant. The stem is first girdled and then wrapped in media like peat moss for working with ease. Proper girdle is the key to causing accumulation of carbohydrates at the cut. Adding hormone to the media or directly applying to the stem is more beneficial. Then the media is enclosedin plastic and tied. Once the roots are formed the layer can be removed from the mother plant and planted.

e) Mound Layering:

It is a type of layering that is useful with heavy-stemmed closely branched shrubs. Cut the plant back to 1 inch above the soilsurface in the dormant season. The dormant buds will produce newshoots in the spring. Mound soil over the new shoots as they grow. Roots will develop at the base of the young shoots. Remove the layers in the dormant season and either transplant directly or place in containers.

f) Tip Layering:

It is a quick way to layer a lot of branches. The branch of the existing mother plant is bent down to the ground and the tips of the branches are essentially buried in 3-4 inches deep holes. The shootgrows into a U shape with roots developing at the bend.

5.4.5. Difference between Layering and Cutting:

Sr. no	Layering	Cutting
1	Layering is performed only on the branches of the plant.	Cutting can be accomplished by using branches, leaves and roots.
2	Plant parts are kept attached to the mother plant till the root formation takes place.	Plant parts are first detached from mother plant and are then induced to produce roots.
3	Layers are produced on the spot and very few layers can be produced from a plant.	Cutting can be taken easily from the plant and can be carried to long distance. More number of cutting can be prepared from a plant.
4	It is complicated and requires different techniques.	It is very easy and simple methods are used.
5	Plants that are difficult to root can be propagated, by layering.	Plants that are easier to root are propagated, by cutting.

5.4.6. Plant Propagation by Specialized Structures

1) Suckers:

A sucker is a shoot on a plant from below the ground. This term is precisely use to designate a shoot arising from an adventitious bud on root. But in practice shoots that arise from the vicinity of the crown are also referred to as suckers, even though they originate from the stem tissue. For e.g. banana, red raspberry, black berry and chrysanthemum.

2) Crowns:

The term crown is used to designate that part of a plant stemthat is below the surface of the ground from which new shoots are produced. Division of the crown is an important method of propagation. E.g. strawberry.

3) Bulb:

A bulb is a specialized underground organ consisting of a short, fleshy, unusually vertical stem axis, at the apex a growing point and enclosed by thick flexi scales. Bulbs are produced by monocotyledon plants, in which the usual structure is modified for storage and reproduction. Bulb scales morphologically are the continuous sheathing leaf bases. The outer scales are normally

fleshy and store reserve food material. Miniature bulbs called bulbets and arialbulblets are called bulbils are separated and used for propagation. E.g. onions.

4) Corms:

A corm is a swollen base of a stem axis enclosed by the dry, scale like labels. It is predominantly leaf scald. A corm is a solid stem structures with distinct nodes and internodes. In mature corm the dry leaf bases persist at each of the nodes and enclose the corm. This covering is known as the tunic which gives protection against injury and water loss. E.g. gladiolus.

5) Tubers (stem tubers):

Stem tuber is the short terminal portion of an underground stem that has become thick due to accumulation of reserve food materials. Propagation by tuber can be carried out either by planting the whole tuber or by cutting it into sections, each containing a bud or an eye. E.g. potato.

6) Tuberous Roots (root tubers):

Certain herbaceous perennial plants produce thickened roots containing large amount of stored food. The tuberous roots lack nodes and internodes. Adventitious buds are present only at stem and these fleshy roots are separated and used propagation.

E.g. sweet potato, dahlia.

7) Rhizomes:

A rhizome is a horizontal stem growing either growing underground or along the surface. It is the main axis of the plant producing roots on its lower surface and extends leaves and flowering shoots above the ground. They may be thick and fleshy orslender and elongated and always have nodes and internodes. Propagation by rhizome is done by cutting or dividing it into sections each of which, is capable of producing new shoot.

8) Runners:

A runner is a specialized stem that develops from the axial ofa leaf at the crown of a plant. It grows horizontally along the ground and forms a new plant at one of the nodes. The rooted daughter plant is dug when they are well rooted and transplanted to the desired locations in propagation by runners. E.g. strawberry.

9) Stolen:

Stolen is a term used to describe various types ofhorizontally growing stems that produce adventitious roots when they come in contact with the soil. These are actually the prostrate stems. The underground stem of the potato the terminal as in tuber is a stolen.

5.5. QUESTIONS FOR SELF-STUDY

1) What are the steps to plan an orchard?

2) Give the different methods of planning an orchard.

3) Explain in brief the planting and selection of plants for anorchard.

4) Give the advantages and disadvantages of sexual propagation in plants.

5) Answer in short- seed germination and seed propagation.

6) Explain- Pre-germination seed treatment.

7) Give the advantages and disadvantages of asexual propagation in plants.

8) Explain plant propagation by cutting.

9) Explain plant propagation by layering. 10)What are the different methods of layering?

10) Give the difference between layering and cutting. 12)Explain plant propagation by specialized structures.

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6

HORTICULTURE III

Unit Structure:

6.1. Grafting

6.2. Budding

6.3. National Horticulture Mission

6.4. National Level

6.5. State Level and district level

6.6. Procedure For Approval and Implementation

6.7. Mission for Integrated Development of Horticulture (MIDH) Schemes

6.8. Organic Farming System

6.9. Summary

6.10. Questions for self-study

6.1. GRAFTING

Grafting is the technique of joining of parts of plants together in such a way that they unite and continue their growth as one plant. The upper part of the graft combination of the new plant is called the scion and the lower part or root is called as the stock.

All the methods of joining plants are termed as grating. When the scion is a small piece of bark or wood containing a single bud then it is called budding.

Reasons for Grafting:

1) To change the size of the resultant plant by dwarfing or increasing growth.
2) To change the form or variety of a plant.
3) To produce earlier flowering and fruiting.
4) To develop a plant tolerant of a wider range of environmental conditions.
5) To increase plants that cannot be reproduced by other asexual methods.
6) To produce nematode or disease resistance.
7) To repair damaged plants (inarching, brace graft, bridge graft).

Grafting is not an easy method of propagation. It requires considerable skill. An experienced grafter only can give high percentage of success.

There are five requirements for any successful grafting operation:

1) There should be compatibility between stock and scion or else they cannot unite.

2) Cambial regions of scion and stock must be in intimate contact. Cut surfaces should be held tightly for proper healing and flow of water and nutrients.

3) Grafting should be done when the stock and scion are in proper physiological stage. Except budding operations scions for all grafting operations should be dormant. Depending on the budding method scions can be either dormant or actively growing. Depending on the grafting method rootstocks can be growing or dormant.

4) All the cut surfaces should be protected from drying out, after grafting is completed. This is done, by covering the graft with wax or tape. Even sphagnum moss a moist material can be used.

5) Until the graft unites proper care must be taken. Shoots from thestock should be removed as they can choke out the scion. Also the shoots from the scion can grow so vigorously that they break the scion off unless staked or tied.

Reasons for grafting and budding of plants:

Plant propagation with cutting and layering is very easy, cheap and economical, however grafting and budding is necessary because -

1) When other methods are not successful grafting and budding can be of help.

2) By using suitable root stock the plant can be made to adapt to pest, diseases, and increase tolerance to cold unsuitable climate.

3) Converting inferior plants into superior plants. E.g. side grafting in mango.

4) To modify the growth of fruit plant. E.g. by using dwarfing root stocks.

6.1.1. Different methods of grafting:

Several techniques of grafting are followed in different plants, suitable in different situations.

1) Scion Attached Methods:

In this method of grafting the scion is kept attached to the mother plant till the graft union takes place and then the graft is separated in stages by taking cut on scion below the graft unionand on root stock above the

graft union. This technique is followed in the following methods.

a) Simple approach or inarching

b) Saddle grafting

c) Tongue grafting

2) Scion Detached Methods:

In this method of grafting the scion is first detached from mother plant and then it is inserted into root stock, so that the union takes place and the combination continues to grow. Following methods are used-

a) Veneer grafting

b) Wedge grafting

c) Saddle grafting

d) Whip grafting

e) Whip and Tongue grafting

f) Softwood grafting

g) Stone grafting

3) Methods of grafting on established Trees:

This method can be successfully used to convert the inferior established plants in to the superior or desired plant. The methods are as follows:

a) Side grafting

b) Crown grafting

c) Top Working

Top working is done in three ways:

i) By inarching the new shoots growing from the cut ends ofbranch of stock plants.

ii) By Forket Budding

iii) By crown grafting

4) Methods of Renovation:

These grafting methods are adopted to rejuvenate the old trees having religious feeling or the plants that are injured deeply due to mechanical operation, pests, diseases at their roots etc.

a) Bridge grafting; **b)** Buttress grafting

6.2. BUDDING :

Budding is the vegetative method of plant propagation. It is defined as " an art of insertion of a single mature bud in to the stem of the root stock in such a manner that the union takes place and the combination continues to grow." It is a type of grafting where an individual bud instead of whole stick on scion is grafted as it is done in grafting. There are several techniques of insertion of bud into the root stock. The adoption of any methods of grafting depends upon the plants to be budded, on the situation, the facilities and sources available, etc.

6.2.1. Different Methods of Budding:

1) Shield Budding:

In this method of budding a single bud with a little wood or without wood is taken from the scion plant and is given a shape of shield before it is inserted into the root stock. This is done in the following three ways-

A) Shield Budding by T method:

i) Selection of Bud Wood or Bud Stock:

Fairly well matured, round bud stick of pencil thickness and of previous season's growth, brownish color, having dormant plumy buds is selected from the desired tree. It must be in sap flowing condition. The leaves are removed from the bud to avoid injuries to the axillary buds.

ii) Selection of Stock Plant:

Vigorous growing stock seedling with pencil thickness having height of about 1½ to 2 feet is selected. The seedling must be in free sap flowing condition.

iii) Removal of Bark from the Stalk Plant:

A vertical cut followed by a horizontal cut across the top at right angle is made carefully with budding knife on the selected seedling (root stock) at the height of about 1½ inch to 2 inches from ground level. The cuts given depend on the wood.

iv) Removal of bud:

A plumy bud is taken out carefully with wood by taking a V1/2 inch below the bud from the selected bud stick. The wood is then removed from the bud along with portion of bark and is given a shape like that of shield.

v) Inserting the bud:

The flaps of bark on either side of the cut on the stock plant are loosened with very potion of budding knife and are kept ready to receive bud. The bud is then inserted from top of the cut and pushed downward beneath the bark, and is held in position.

vi) Bandaging:

To bring about a firm cambial contact the operated portion is tied with banana or polythene strip and the growing point of bud is kept exposed.

Under normal condition union takes place in about 5 weeks.

B) Shield Budding 'I' Method:

This method is adopted in the regions of heavy rains. The technique used in this method is the same as that used in T methodexcept that the incision on the stock has the transceivers taken on the root stock and is bent so that the bark becomes loose. Then the bud is inserted and tied firmly with a string. Union takes place within2-3 weeks.

C) Simple Shield Budding by Insertion Method:

A simple length-wise incision is done on the root stock. It is bent to make the bark loose. Then the bud is inserted and tiedfirmly with a string. Union takes place within 2-3 weeks.

2) Patch Budding:

It is a slow and difficult method of budding. But is a successful method widely used on the plants having thick bark. The patch of the bark is removed from the stem of the root stock. The patch of bud exactly the same size is removed from the bud stock taken from the desired tree and is tightly fitted on the root stock of the exposed area and a polythene film is tied around it to protect it. This method is most suitable for mango plant. The most suitable months for patch budding in mango are September and October.

3) Flute Budding:

In this method use of rings tissues adjoining the bud of a relatively thick barked tree are done. The thick barked tree thicker than 1 cm and in active stage is commonly budded by this method. For e.g. in ber and cashewnut.

4) Ring Budding:

This method is more or less an extension of flute method. Budding operation is done when the plant is in sap flowing condition. A complete ring of bark is removed around the stem of the stock in order to form a matrix. A complete ring of the bark of the same with a prominent, plumy, healthy bud is removed from bud stick when placed on stock; it extends all around the stock. After placing the ring in position tying is done in usual manner.

5) Forket Budding:

A fair degree of success has been achieved in mango by this method in Maharashtra. The selection of the bud sticks as well as the root stock is the same as that in the shield budding. At the height of about 9-12 inches from the ground level horizontal cut is taken on the root stock and

then two vertical cuts from the either end of the horizontal cut extending downwards are taken and a flap of bark is pulled out exposing a rectangular portion of about 1-2 inches on the root stock. A rectangular piece of bark along with a matured primary bud of the same size 1-2 inches is removed from the selected bud stick. This piece of bark is fitted on the exposed portion of root stock and is well protected. The panel of the bark then is released to its original position. It is then tied with a string asusually done. Manuring and watering the rootstock is carried out as and whenever necessary. After 15 days the strip is removed and the panel of bark is pulled again to see the inside portion. If bud is seen sprouting the panel of the bark is removed by taking horizontal incision on the downside of its root stock. The bud is again tied keeping exposed the growing point in a usual way. The same procedure is again followed after 15 days if the bud growth is not seen. Within 3-5 weeks of operation the bud sprouts.

6.3. NATIONAL HORTICULTURE MISSION (NHM)

National Horticulture Mission (NHM) is being implemented in all the States and Union Territories of India except the North Eastern States, Himachal Pradesh, Jammu & Kashmir andUttaranchal to promote holistic growth of the horticultural sector covering fruits, vegetables, roots and tuber crops, mushroom, spices, flowers, aromatic plants, cashew and cocoa, There is a separate Technology Mission for integrated development of horticulture exists in the North Eastern States, Himachal Pradesh, Jammu & Kashmir and Uttaranchal. Program for the development of coconut is implemented by, the Coconut Development Board (CDB) independent of the mission. This is a centrally sponsored scheme in which Government of India provides 100% assistance to the State Mission. But in the XI plan assistance of 85% from central government and 15% contribution by the state governments was provided.

6.3.1.Mission Strategy:

To achieve the objectives of the National Horticulture Mission, the mission adopted following strategies-

1) Ensure end-to-end holistic approach covering production, post harvest management, processing and marketing to assure appropriate returns to the growers / producers.

2) Promote R&D technologies for production, post-harvest management and processing.

3) Enhance acreage, coverage and productivity through-

a) Diversification from traditional crops to plantations, orchards, vineyards, flower and vegetable gardens;

b) Extension of appropriate technology to the farmers for high- tech horticultural cultivation and precision farming.

4) Assist setting up post-harvest facilities such as pack house, ripening chamber, cold storages, Controlled Atmosphere (CA) storages etc., processing units for value addition and marketing infrastructure.

5) Adopt a coordinated approach and promotion of partnership, convergence and synergy among R&D, processing and marketing agencies in public as well as private sectors, at the National, Regional, State and Sub State levels.

6) Where appropriate and feasible, promote National Dairy Development Board NDDB) model of co-operatives to ensure support and adequate returns to farmers.

7) Promote capacity- building and Human Resource Development at all levels.

6.4. NATIONAL LEVEL

a) General Council:

The Mission will have a General Council (GC) at the Nationallevel under the Chairmanship of the Union Agriculture Minister. Thecouncil will be the policy making body giving overall direction and guidance to the Mission, and will monitor and review its progress and performance. The GC will meet at least twice a year.

Executive Committee – Government of India level

There will be an executive Committee (EC) headed by the Secretary, Department of Agriculture & Cooperation to oversee the activities of the mission and to approve the Action Plans.

The EC will be empowered to reallocate resources across States and components and approve projects on the basis of the approved subsidy norms. EC will use its discretion in approving components of a project for which norms have not been prescribed. The subsidy for such components will be not more than 50% of the cost for small and marginal farmers and 30% of the cost for other farmers.

The Horticultural Division in the Department of Agriculture & Cooperation will provide the necessary support to the EC and the GC and will administer the NHM. The EC will ensure smooth functional linkages among different agencies. The EC shall meet every quarter but at least once in two months in the initial stages of the Mission.

6.5. STATE LEVEL

A State Level Executive Committee (SLEC) will be constituted by the State Government under the Chairmanship of the Agricultural Production Commissioner, or Secretary Horticulture/ Agriculture having representatives from other concerned departments, the SAUs, ICAR institutes, Growers Associations, etc.for overseeing the implementation of the program. Central Government will nominate its representative who

will be a Member in the SLEC. The State Mission Director to be appointed by the State Government will have the freedom to nominate, or create a suitable autonomous agency to be registered under the Societies Registration Act for implementing the Mission Program at the state and District levels. The Panchayati Raj Institutions existing in the State should be fully involved in the implementation structure. Stateand Sub-State level structures will be evolved keeping in view the need for getting adequate returns for the produce of the farmersand eliminating middlemen to the extent possible. The State will have the flexibility to adopt an appropriate model viz. cooperative federations in the pattern of NDDB, incorporated companies (with cooperatives for procurement, joint sector for processing and cooperates for marketing) or orient existing institutions to carry out the tasks of the Mission. The services of identified State Designed Agencies, which have been implementing various horticulture development programs such as Integrated Development of Horticulture in Tribal / Hilly Areas, Development of Beekeeping, may be availed for implementing the program in the Mission framework.

The State level agency will have the following functions.

a) Prepare perspective and annual State level Action plan in consonance with Missions goals and objectives and in closes coordination with Technical Support Group, State Agriculture Universities (SAU) and ICAR institutions and oversees its implementation.

b) Receive funds from the National Mission Authority, the State Government and other sources for carrying on the missionsactivities, maintain proper accounts thereof and submit utilization certificate to the concerned agencies, release funds to the implementing organizations and oversee, monitor and review the implementing of the program.

c) Organize base-line survey and feasibility studies in different parts (District, Sub-District, or a group of Districts) to determine the status of horticultural production, its potential and demand and tailor assistance accordingly. Similar studies would also be undertaken for other components of the programs.

d) Assist and oversee the implementation of the Missions programs in the State through Farmers, Societies, and NOs growers associations, self-help groups, State Institutions and other similar entities.

e) Organize Workshops, Seminars and training programs for all interest groups / associations at the state level, with the help of State Agriculture Universities and ICAR institute another institutions having technical expertise.

6.5.1.District Level:

At the District level, the District Mission Committee (DMC) will be, constituted by the State Government. It will be responsible for project formulation and monitoring. The DMC may be headed by the Chief Executive Officer (CEO) of Zilla Parishad / CEO of District Rural

Development Agency (DRDA) having its members, representatives from concerned line Departments, Growers Associations, Marketing Boards, Self-help Groups and other Non- Governmental Organizations. The District Planning in implementing the program depends on their expertise and available infrastructure. The Districts Horticulture Officer / District Agriculture Officer will be the Member Secretary.

6.6. PROCEDURE FOR APPROVAL AND IMPLEMENTATION

State will be required to prepare a State Horticulture Mission Documents (SHMD) projecting a plan of action and will form the basis for preparing Annual Action Plans (AAP). The AAP will be area based, on the basis of existing potential for horticulture development, available infrastructure for monitoring and implementation, available unspent balance out of previous releases and capacity to absorb the funds in commissioning the project. The Ministry of Agriculture would communicate the tentative outlay for the year by April / May if not earlier to each State which in turn will indicate sector-wise / district-wise allocation.

The agencies at the District level will prepare the annual action plan (AAP) keeping in view their priority and potential and submit the plan to the State Horticulture Mission. The State could engage TSG / Consultancy services for preparing the SHMD and AAP. The State Horticulture Mission in turn will prepare consolidated proposal for the state as a whole, get it vetted by the State Executive Committee (SEC) and furnish 25 copies of the same to the Ministry of Agriculture (MOA) for consideration by the National Executive Committee. The SHM may spend up to 5% of the annual allocation for formulating the SHMD and Annual Action Plans. Attempt would be made in the AAP to address all the issues relating to horticulture development covering production, post- harvest management and marketing.

The SHM will upload the AAP, as communicated to theNational level EC indicating approval by SLEC, on the web site exclusively created for the purpose. The same will be replaced afterits approval by national level EC. Attempt will be made to display the position regarding the AAP on line.

6.7. MISSION FOR INTEGRATED DEVELOPMENT OFHORTICULTURE (MIDH) SCHEMES- NHM

National Horticulture Mission (NHM) is one of the sub- scheme of Mission for Integrated Development of Horticulture (MIDH), which is being implemented by State Horticulture Missions (SHM) in selected districts of 18 States an four Union Territories. For availing benefits and assistance under the scheme, farmers / beneficiaries should contact the Horticulture Officer of concerned district. Operational guidelines, cost norms of different interventionsbeing promoted under the mission etc. are available on NHM website.

HMNEH-

Horticulture Mission for North East & Himalayan States (HMNEH) is one of the sub schemes of Mission for IntegratedDevelopment of Horticulture (MIDH), which is being implemented by State Horticulture Missions (SHM) in the North Eastern States and Himalayan States. For availing benefits and assistance under the scheme, farmers / beneficiaries should contact the Horticulture Officer of concerned district. Operational Guidelines, cost norms of different interventions being promoted under the mission, etc. are available on HMNEH web site.

NBM-

National Bamboo Mission (NBM) is one of the sub schemes of Mission for Integrated Development of Horticulture (MIDH) which is being implemented by State Bamboo Development Agencies (BDA)/ Forest Development Agency (FDA) in all the States and UTs. For availing benefits and assistance under the scheme, farmers / beneficiaries should contact the Officer of BDA/FDA in the concerned district. Operational Guidelines, cost norms of different interventions being promoted under the mission, etc. are on NBM web site.

NHB-

National Horticulture Board (NHB) is implementing various Schemes under Mission for Integrated Development of Horticulture (MIDH) in all States and UTs. For availing benefits and assistance under NHB scheme, farmers / beneficiaries should contact the Regional Office of NHB or NHB Headquarters. Operational Guidelines, cost norms of different interventions being promoted by NHB, etc. are available on NHB website.

CDB-

Coconut Development Board (CDB) is implementing various Schemes under Mission for Integrated Development of Horticulture (MIDH) in all Coconut growing states in the country. For availing benefits and assistance under CDB, farmers / beneficiaries should contact the Regional Office of CDB or CDB Headquarters. Operational Guidelines, cost norms of different interventions being by CDB, etc. on CDB website.

CIH-

Central Institute for Horticulture (CIH) was established at Medizipehima, Nagaland in 2006-07 for providing technical back stopping through capacity building and training of farmers and Fieldfunctionaries in the North Eastern Region.CIH now one of the sub schemes of MIDH. However, CIH is not implementing any schemesdirectly.

IIHR-

The Indian Institute of Horticultural Research (IIHR) is an autonomous organization acting as a nodal agency for basic, strategic, anticipatory and applied research on various aspects of horticulture

such as fruits, vegetable, ornamental, medicinal and aromatic plants and mushrooms in India.

6.8. ORGANIC FARMING SYSTEM- AN INTEGRATED APPROACH FOR ADOPTION UNDER NATIONAL HORTICULTURE MISSION:

During the last two decades, there has been a significant sensitization of the global community towards environmental preservation and assuring of food quality. Ardent promoters of organic farming consider that it can meet both the demands and become the means for complete development of rural areas. After many years of neglect, organic farming is now finding place in the mainstream of development. It shows great promise environmentally, socially and commercially. It has environmental sustainability and productivity at its core, healthy soil, healthy food and healthy people.

Definition of Organic Farming:

Organic farming is a method of farming system, which primarily aims at cultivating the land and raising crops in such a way, so as to keep the soil alive and in good health. It is the use of organic wastes (crop, animal and farm wastes, aquatic waste) and other biological materials, along with beneficial microbes (bio- fertilizers) to release nutrients to crops, which connotes the organic nature of organic farming. In Indian context it is also known as "Jaiv-Krishi".

Concept of Organic Farming:

It is based on the following principles.

1) Nature is the best role model for farming. it neither uses any input nor demand unreasonable use of water.

2) The entire system is based on intimate understanding ofnature's ways of replenishment.

3) The soil in this system is considered as a living entity.

4) The soils living population of microbes and other organisms are significant contributors to its fertility on a sustained basis and must be protected and nurtured, at any cost.

5) The total environment of the soil, from soil structure to soil coveris more important and must be preserved.

6.9. SUMMARY:

Importance of fruits in human is very essential. Man cannot just live on cereals. Fruits and vegetables are necessary for good health and also for balanced diet. Human body cannot maintain proper health and develop resistance to diseases without fruits and vegetables as they are a good

source of vitamins and minerals. Fruits and vegetables also contain pectin, cellulose that stimulates intestinal activities and energy giving substances like oils, fats and proteins. Many fruits also serve as medicines.

Over the years, horticulture has emerged as one of the potential agricultural enterprise in accelerating the growth of economy. Role of horticulture has become very important in the country's nutritional security, poverty alleviation and employment generation programs. It has offered a wide range of options to the farmers for crop diversification and ample scope for sustaining large number of Agro-industries generating huge employment opportunities.

On account of significant production increase in the horticultural crops across the country, India has emerged as a leading player in the global scenario. We are the largest producer of coconut and tea and the second largest producer and exporter of tea, coffee, cashew, spices, and export of fresh and processed fruits, vegetables, cut flowers and export of dried flowers is also picking up.

Horticulture in India today has become a sustainable and viable venture for the small and marginal farmers because of a number of thoughtful research, technological and policy initiatives and inputs. As a result their food consumption and household income have increased.

Horticultural sector has attracted entrepreneurs for taking up as a commercial venture.

Plantation crops assume great importance in Indian horticulture. It is a rich source of national income. Fruits have great demand in the international market, and they are one of the potential earners of foreign exchange. Therefore there is a great scope for the horticulture industry to grow and flourish.

6.10. QUESTIONS FOR SELF-STUDY:

1) What is Grafting?
2) What are the different methods of grafting?
3) Explain budding and its different methods.
4) Explain National Horticulture Mission (NHM) at national level.
5) Explain National Horticulture Mission at state and district level.
6) Give the different schemes under Mission for Integrated Development of Horticulture.
7) Write short note on:

a) National Horticulture Mission

b) Shield budding by T method

c) Organic farming

❖❖❖❖

7

FORESTRY – I

Unit Structure:

7.1. Objectives

7.2. Introduction

7.3. Uses of forest

7.4. Types of forests

7.5. Other classification of Indian forests

7.6. Forests Products and their Uses

7.7. Forest in Maharashtra

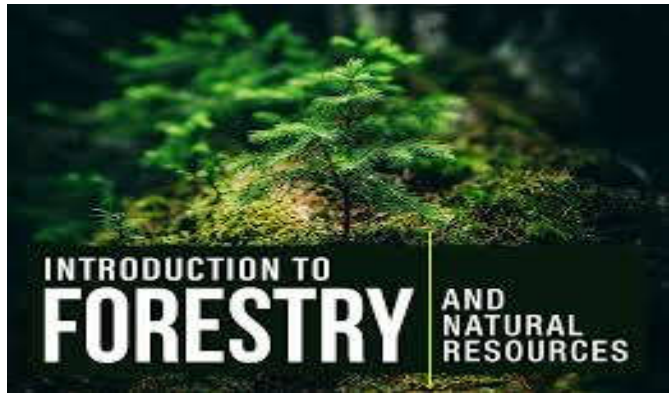
7.8. Questions

7.1. OBJECTIVES :

To know-

1) The forests in India and its importance.
2) Various types of forests in the country.
3) Various forest products and forest based industry.
4) Deforestation
5) Social Forestry
6) India's forest policies and laws.

7.2. INTRODUCTION :



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Forests in India are ancient in nature and composition. They are rich in variety and shelter of wide range of flora and fauna. The ancient people have preserved forests and a large number of religious ceremonies are centered on and near trees and plants. Even today in many parts of India the sacred groves exists and are worshipped. India possesses a distinct identity, not only because ofits geography, history and culture but also of its diversity of its natural ecosystem. The Indian forests ranges from evergreen tropical rain forests in the Andaman and Nicobar Islands, the Western Ghats, and the North Eastern states, to dry alpine scrub high in the Himalaya to the north. In between the two extremes, the country has semi-evergreen rain forests, deciduous monsoon forests, and thorn forests, subtropical pine forests in the lower zone andtemperate forest.

Forestry in India is a significant rural industry and a major environmental resource. India is one of the ten most forest-rich countries of the world. Forest cover of India has increased by 5,081square km between 2013 and 2015. The India State Forest Report 2015 released showed that the country's carbon stock has also increased by 103 million tons.

Forests are essential for the sustainability of planet earth. Forests command great influence on the climate, soil, and environment of our world.

India is one of the largest consumer of fuel wood, which is five times higher than what can be sustainably be removed from theforests. A large percentage of this fuel is grown as biomass remaining from agriculture and is managed outside forests. Forestry in India is more than just about wood and fuel. India has a thriving non-wood forest products industry, producing latex, gums, resins, essential oils, flavors, fragrances and aroma chemicals, incense sticks, handicrafts, thatching materials and medicinal plants. Non-wood forest product consumption locally is around 60% and gives total revenue of 50% from the forest industry in India from non-wood forest product category.

7.3. USES OF FORESTS:

People began life on this planet as forest dwellers. They were food gatherers and completely depended on the forest for all their basic needs like food, clothing and shelter. Gradually they began to grow food by clearing a small patch in the forest to grow food. But the dependence on forest was and is continued till today for paper, timber, fuel-wood, medicine, fodder, medicinal plants, gum, lac, etc. Forest plays a vital role in the Indian economy.

A) Direct use of forest –

It protects the wild life. It provides material for industry. It also attracts rain and stop soil erosion. The evergreen forest yield hard wood such as teak rose wood and bamboos. The monsoon forests provide teak, Sal, sandalwood, etc. The hill forests give the best timber and other trees. Eucalyptus trees can be planted to attract rain. In India there are over

20,000 types of medicinal plants. Around 25% of all drugs are derived from trees. Trees also yield vital industrial oils, resins and dyes.

Forests maintain the ecological balance of the country. So forests are of great value to us.

Fuel-wood –

Wood is an important source of energy for cooking and heating for the rural population. Smaller stems are preferred as it is easy to collect and carry. The wood collected should be easy tosplit and have low moisture content to dry faster. Some of the woodis converted to charcoal and used for cooking.

Fodder –

Fodder from forest is an important source for cattle and other grazing animals in the hilly and the arid regions. They are also useful during a drought. Many varieties of grasses, trees and shrubs are nutritious for the livestock. Trees that produce a large crown above the reach of cattle are preferred.

Fencing –

In developing countries fencing with trees and shrubs are preferred as they are cheap to maintain by giving protection. The plant species preferred are those having thorns or are prickly and have stiff branches and non-edible leaves. The species selected should be fast growing, hardy and long-lived.

Wind Breaks and Shelter Belts –

Trees grown for wind breaks are bushy and sturdy to withstand hot and cold strong winds. Casuarina trees have been successful to check degradation due to salt laden coastal winds. P. Juliflora planted have successfully stopped the advance of the desert along the desert border.

B) Indirect use of forest –

The best friend of earth and man is the tree. We have the greatest resources on the earth if we use it respectfully and economically. In short we can say forest are the treasure-troves of useful things to man and animals.

Cooling the environment:

Forest are the lungs of the earth as they absorb the carbon dioxide released by the burning of fuel by man and keeps air fresh and is used by the leaves to produce food during photosynthesis. The oxygen released thereafter a by-product of photosynthesis is released in the atmosphere is necessary for all the living organisms on earth for respiration. No animal or plant can survive without oxygen. The roots of trees help in absorbing the water from the ground and supply it to the leaves. The excess water is sent out through the stomata and is released into the atmosphere and cools down

the environment surrounding the forest and its neighborhood. As a result the forest have a cooling effect.

Prevent soil erosion:

The roots of the trees bind the soil preventing erosion caused by wind or water. Leaf fall provides a cover to the soil and protects the soil. Casuarina plant helps in binding the sand and stabilizes the sand dunes in the area.

Regulate the flow of water:

Roots of the trees absorb much of rainwater, and use it slowly during the dry season, thus regulating the flow of water and help in controlling floods and famines. Trees check the flow of running water.

Increase the fertility of soil:

Rotting of the dead leaves and animals in the forest improve the fertility of the soil. Forest cover prevents soil erosion. The fallen leaves of trees add humus to the soil after their decomposition. Some species of trees have the ability to fix nitrogen in the soil through decomposition of fallen leaves. They have the nitrogen- fixing bacteria. So such trees are to be planted to increase the nitrogen content in the soil. Thus forests help in increasing the fertility of the soil.

Check on the spread of deserts:

Forests checks on the spread of deserts. The roots of the trees and plants bind the sand particles and do not allow their easy transportation by winds. In the long run forests add humidity to the atmosphere and help in checking the spread of deserts.

Forest helps in balancing the carbon dioxide and oxygen in the atmosphere and regulates the earth's temperature and weather cycle. They enhance the local rainfall. They prevent landslide and floods.

Effect on Temperature:

Forests have a far-reaching effect on climate. They ameliorate the extremes of climate by reducing the heat in summers and cold in winter. They also influence the amount of rainfall by lowering the temperature of moisture-laden winds and increase relative humidity of air through the process of transpiration. The transpiration from the leaves increases the cloud formation bringing plenty of rain. They reduce the surface velocityof winds and slow down the process of evaporation.

7.4. TYPES OF FORESTS:

The forests of India can be classified into several types. These are- Taiga type (consisting of pines, spruce, etc.), the mixed temperate forests with both coniferous and deciduous trees, the temperate forests, the sub-tropical forests, the tropical forests and the equatorial rainforests. These forests are related with the surrounding atmosphere and their range is very

diverse. We can see that forests are distributed from the rain forests of Kerala in the south to the Alpine pastures of Ladakh, from the desert of Rajasthan in the west to the evergreen forests in the North East.

Some definitions of forests:

Forest cover:

All lands, more than one hectare in an area, with a tree canopy density of more than 10% is called forest cover. Such lands may or may not be statutorily notified as forest area.

Very Dense Forest:

All lands, with a forest cover with canopy density of 70% and above

Moderately Dense Forests:

All lands, with a forest cover with canopy density of 40-70%

Open Forests:

All lands, with forest cover with canopy density of 10-40%

Mangrove cover:

Mangrove forest is salt tolerant forest ecosystem found mainly in tropical and sub-tropical coastal and /or inter-tidal regions. Mangrove cover is the area covered under mangrove vegetation. It is a part of forest cover and is classified into three classes viz. very dense, moderately dense and open.

Non -Forest Land:

It is defined as lands without any forest cover

Scrub Cover: Defined as all lands generally in and around forests areas, having bushes and or poor tree growth, chiefly small or stunted trees with canopy density less than 10%

Tree cover:

Land with tree patches (blocks and linear) outside the recorded forest area exclusive of forest cover and less than the minimum mapable area of 1 hectare

Trees Outside Forests:

Trees growing outside Recorded Forest Areas

Different types of forests are:

1) Tropical Evergreen:

These forests are mainly found in the areas having average annual rainfall over 150 cm and temperature varies between 25° to

27° C -- North-East India, parts of Western Ghats, the Andaman and Nicobar, upper Assam, lower slope of Eastern Himalayas, Orissa, along the foothills of Himalayas, Bhabar and Tarai regions. In the areas where the average annual rainfall is more than 250 cm, the forests are dense; composed of tall trees (45m). Trees have multi-stored structures with good canopies. The trees do not shed their leaves annually and are hence evergreen. The ground lacks grasses because of deep shade. However there are canes, palms, bamboos, ferns, and climbers making the passage difficult. Due to poor accessibility these forests have not been exploited properly. Inthe areas where rainfall varies between 200 to 250 cm and the mean monthly temperature varies between 24° to 27°C, the evergreen forests degenerate into semi-evergreen forests. These forests are found along the Western Ghats, Upper Assam, slopesof Himalayas and Orissa.

2) Tropical Moist Deciduous:

These are typical monsoon forests with teak and sal as the dominant species. The tropical moist deciduous forests are found inthe Sahayadris, the North Eastern parts of the peninsula and along the foothills of Himalayas. They form the natural vegetation all over the country where average annual rainfall ranges between 100 to 200 cm. the typical landscape consists of tall teak trees with sal, bamboos and shrubs growing fairly close together to form thick trees. The trees grown here are Teak, Sal, Sandalwood, Shisam, Hurra and Khair are economically important trees.

3) The sub-tropical Montane Forests:

These forests are found in the areas having average annual rainfall between 100 to 200 cm and the temperature varies between15°and 22°C. they are found in the North-Western Himalayas (except in Ladakh and Kashmir), Himachal Pradesh, Uttarakhand, sikkim, Arunachal Pradesh and on the slopes of the North-Eastern hill states. Trees having broad leaf are found in these areas but pine is the main tree. Oak Jamun and rhododendron are the other trees found in these forests.

4) The Tropical Thorny Forests:

It is a degraded version of the moist deciduous forest. They are found in e areas having average annual rainfall between 75 and 100 cm and the average annual temperature between 16° and22.5°C. these forests are found in peninsular India, rajasthan, Haryana, Punjab, Western Uttar Pradesh, kachh, Madhya Pradesh and the foothills of the Himalayas. The important trees found in this area are acacia, wild-palms, euphorbias, jhad, tamarix, khair, kokko, dhaman, cacti, kanju and palas.

5) The Dry Deciduous Forests:

These forests are found in the areas where average annual rainfall is between 100-150 cm. they are characterized by uneven canopies due to which enough light reaches the ground for the growth of grasses and climbers. Grasses and shrubs appear duringthe general rainy season. The main trees grown in these forests are acacia, jamun, modesta and pistacia.

6) The Himalayan Moist Forests:

These are found in Jammu and Kashmir, Himachal Pradesh, Uttarakhand and northern hilly parts of North Bengal. The wettemperate type of forest is found in a belt with an altitude varying between 1000 and 2000 meters. They are as bands of crested dark green landscape of coniferous varieties. Oak, chir, chestnut, sal, shrubs and nutritious grasses are the important varieties of trees found in these forests.

7) The Himalayan Dry Temperate Forests:

These type of forests are seen in Jammu and Kashmir, Lahul, Chamba, kinnaur (Himachal Pradesh), and Sikkim. These are coniferous type forests with shrubs. Deodar, oak, chilgoza, ash, maple, olive, mulberry, willow, celtis and parrotia are the important varieties of trees found here.

8) Montane Wet Temperate Forests:

Himalayas from Jammu and Kashmir to Arunachal Pradesh between the altitudes of 1500m to 3300m where the temperature varies between 12° C to 15°C, and the mean annual rainfall is between 100 to 250 cm, these type of forests are found. The trees found here are Oak, Fir, Spruce, Picea, Deodar, Magnolia Celtis, Chestnut, Cedar, maple, silver-fir, Kail and Yew. These forests also contain scrubs, creepers, and ferns. The wood obtained from these forests is durable.

9) Alpine and Sub-Alpine Forests:

These forests are found all along the Himalayas at an altitude ranging from 2500 to 3000m. The characteristic of these forests is that it has short dwarf conifers and lush green nutritious grasses during the summer season. Kail, spruce, yew, firs, birch, honeysuckle, artemesia, potentilla and small scrubs are the trees found in this zone.

10) Desert Vegetation:

It is seen in the west of Aravallis in the state of Rajasthanand northern Gujarat. The diurnal and annual range of temperature is high and the average annual rainfall in this zone is less than 50 cm. The main trees in the desertsare acacia, cacti, jhar and khejra,kanju and wild palms.

11) Tidal (Mangrove):

This type of forests is found along the coastal areas of the Bay of Bengal in the states of West Bengal, Orissa, Andhra Pradesh and Tamil Nadu and along the coasts of Kachchh, Kathiwar and Gulf of Khambat. Wherever there are frequent tides these types of forests are found. The mangrove attaining height up to 30 m is the most important tree and is utilized for fuel. Sundarban is covered by the sundri trees supplying hard durable timber for construction and boat making. Higher grounds support screw pines and palms occupy creeks and epiphytes are predominant all over the region.

Five largest mangroves and swamp forests in India:

Mangrove Forest is the home of different varieties of trees, low and medium height, etc. The swamps protect coastal areas of India and home to so many species of aquatic birds, water animals and reptiles.

Sundarbans Mangroves:

The Great Sundarbans is the largest in the world. It is a UNESCO World Heritage Site. This region is densely covered with mangroves. It is a National Park, Tiger Reserve and a Biosphere Reserve Park of India.

Bhitarkanika Mangroves:

it is the second largest forest in India located in Orissa. Bhitarkarnika is created by the two rivers delta of Brahmani and Baitarani rivers and is one of the important Ramsar Wetland in India.

Godavari Krishna Mangroves:

This mangrove lies in the delta of Godavari and Krishna rivers in Andhra Pradesh. It is under the protection of Calimere Wildlife and Pulicat Lake Bird Sanctuary.

Pichavaram Mangroves:

It is situated at Pichavaram near Chidambaram in TamilNadu. They rank among one of the most exquisite scenic spot in Tamil Nadu and is a home of many species of aquatic birds.

Baratang Island Mangroves:

It is a beautiful swamp located at Great Andaman and Nicobar Islands. Mangrove swamps of Baratang are situated between middle and south Andamans, capital city Port Blair.

Myristica swamp of Karnataka, Western Ghats, Konkan, Gujaratand mangroves of Kollam are few more sites of wetland in India.

7.5. OTHER CLASSIFICATION OF INDIAN FORESTS:

Apart from the major classification of Indian forests described above, the Indian forests can be classified on the basis of statutes, ownership, composition and exploitability.

1) Legal or Administrative Classification:

This classification is done so as to protect the forests againstindiscriminate destruction. The Indian forests are divided into (a) Reserved, (b) Protected and (c) Un-classed.

Reserved and protected forests are permanent forests. They are maintained for regular supply of timber and other forests products as well as ecological reasons. The **reserved** and **protected** forests areas

cover the total forest area of about 54% and 29% respectively. The **un-classed forests** cover around 17% of the total forest areas and are largely degraded, unproductive and unprofitable.

2) Classification based on Ownership:

The government through different departments such as forest department owns most of the forests. Some of the forest land is owned by corporate bodies. A negligible portion of less than 1% is privately owned. Some forest land in Meghalaya, Orissa, Punjab and Himachal Pradesh is privately owned.

3) Classification according to Composition:

According to the composition there are mainly two types of forests (a) Coniferous Forests and (b) Broad leaved.

(a) Coniferous Forests:

They cover only 3.5 million hectares and are mainly found in the Himalayan ranges. Deodar, chir, fir, spruce, pine, etc. are some of the species of coniferous forests. Due to their inaccessibility, difficult terrain and lack of transport facilities they are not properly exploited though they contain valuable softwood timber.

(b) Broad Leaved Forests:

They are widely spread and cover about 95% of the total forest cover of India. It is a provider of valuable timber and sal and teak are the most important species in these forests and they cover an area of about 16.55% and 13.2 % of the total area under broad- leaved forests respectively. 7.48% of the total area is covered by Bamboo. Rosewood, Indian laurel, shistram, garyan and benteak are the other species of the broad-leaved forests.

4) Classification according to Exploitability:

The forests can be classified into (a) Exploitable, (b) Potentially Exploitable and (c) Others from the exploitability point of view. About half of our forests are exploitable and one fourth are potentially exploitable. Most of the exploitable forests supply non- coniferous timber. These forests are found in Assam, Arunachal Pradesh, Tripura, Western Ghats, Satpura, Maikal, Chota Nagpur plateau, Andaman and Nicobar Islands, Orissa, and the adjoining areas of Andhra Pradesh and Chattisgarh. In others category a large portion of our forests are inaccessible for effective exploitation and are also termed as non-merchantable. As they are in the high mountains of Himalayas in Kashmir and Arunachal Pradesh they cannot be exploited due to lack of transport facilities.

7.6. FORESTS PRODUCTS AND THEIR USES:

A forest product is any material derived from a forest for direct consumption or for commercial use, such as lumber, paper, or forage for livestock. Wood the dominant forest product is usedfor many purposes – wood fuel in the form of firewood or charcoal, or the finished structural material used for construction of buildings, or as raw material in the form of wood pulp used for making paper. All the other wood products derived from forest resources, comprising a broad variety of other forest products, are collectively described as non-timber forests products.

Forest produce is defined under section 2(4) of the Indian Forest Act, 1927. Its legal definition includes timber, charcoal, caoutchouc, catechu, wood-oil, resin, natural varnish, bark, lac, myrobalans, mahua flowers (whether found inside or brought from a forest or not), trees and leaves, flowers and fruits, plants (including grass, creepers, reeds, moss), wild animals, skins, tusks, horns, bones, cocoons, silk, honey, wax, other parts or produce of animals, and also includes peat, surface soil, rocks and minerals etc. when found inside or brought from a forest, among other things.

Forest produce can be divided into several categories. Forest produce can be categorized into three types, from the point of usage – Timber, Non Timber and Minor Minerals. Non Timber Forest Products (NTFPs) are also known as Minor Forest Produce (MFP) or Non-Wood Forest Produce (NWFP). The NTFP is further categorized into Medicinal and Aromatic Plants (MAP), oil seeds, fiber and floss, resins, edible plants, bamboo, reeds and grasses.

Timber:

More than 1500 species of trees are commercially exploited for timber in different parts of India. It is used in timber based industries such as plywood, saw mills, paper and pulp, and particleboards.

Bamboo:

Bamboo is common in the north-eastern and the south- western parts of India, growing along with the deciduous or evergreen forests. The main commercial use of bamboo is as timber substitute, fodder, raw material for basket, paper and pulp, and other small-scale industries.

Cane:

Cane or rattan is the stem of a climber plant. They are used for a large number of household items like walking sticks, polosticks, baskets, picture frames, screens, and mats.

Grasses:

Hundreds of varieties of grasses are there in the forests of our country nd are used for anumber of purposes. Lemon grass, palmrose grass, bhabbhar and khus are some of the varieties.

Fruit:

Fruit trees are an important source of income and food for the rural household. Fruit trees are commonly planted in some areas along the field borders and around the wells. Mango, coconut, orange, pear, jackfruit, jamun, black berry, karvanda and many other fruit trees grow wild in the forests.

Medicinal Use:

Since ancient times humans have depended on the forests to cure themselves of various ailments. Now also man is dependent on the forest for herbs and plants to fight against diseases. Neem is the most important trees of the medicinal trees found in India. Leaves bark and other parts of many trees are used to make various ayurvedic medicines due to their medicinal value.

Fiber:

Plant fiber has many uses. Soft fibers like jute are derived from the stems of a plant. Hard fiber is derived from leaves of hemp and sisal is used to make fabrics for different applications. Coir is another form of fiber obtained from the coconut plant and is used for making ropes.

Floss:

Many species of Indian fruit trees produce a silky floss, which is used to make cotton wool, mattresses and pillows. The most common species is Simal.

Essential oils:

The source of essential oils from tropical grasses is lemon grass, citronella and khus. Oil is distilled from the wood of various species such as sandalwood, agar and pine. Oil is also derived from certain plant leaves like eucalyptus, camphor, wintergreen and pine. These oils are used for making soaps, cosmetics, incense, pharmaceuticals and confectionery.

Biodiesel:

Biodiesel is a clean burning alternative fuel, produced from domestic, renewable resources. Biodiesel contains no petroleum, but can be blended at any level with petroleum, diesel to create a biodiesel blend.

7.7. FORESTS IN MAHARASHTRA:

Every state in India has different types of forests. Maharashtra also has different types of forest. Forests in Maharashtra are on the konkan coast, the sahyadris, the deccan Plateau and the vidharbha region of Maharashtra.

1) Forests on the Konkan Coast:

The different types of forests on the konkan coast include intertidal swampy forests, deciduous forest and semi-evergreen forests. The mangrove forests are the significant intertidal swampy forests of the konkan coast are currently under tremendous pressure from urbanization and industrialization. Mangroves in Mumbai also are getting exploited and are in danger due to the large-scale urbanization in the metropolis and the biotic threats and human interference (agriculture, solid waste disposal, industry, mining, etc.) and grazing.

2) Forests in Sahyadris:

The Crestline of the Sahyadri forest is also called "GhatMaatha" as it has the tallest peaks as well as the highest plateau that cover the entire range. The Sahyadris have evergreen forests on the wet areas along the crest due to cool temperature and heavy rainfall. Dry deciduous forests along with grassland are seen in the dry and shallow areas of the crest. Brahmi, Aloevera, Ashwagandha, Tulsi are the herbs from sahyadris.

3) Forests on the Deccan Plateau:

Moist deciduous forests are seen on the Eastern Coast and dry deciduous forests on the Central and Southern Deccan Plateau. The moist deciduous forests of Vidarbha run along the low hills of the northern sections of the eastern ghats of Andhra Pradesh, and cover the eastern parts of the Satpura range in Madhya Pradesh.

The dry deciduous forests on the Central Deccan Plateau covermost of the Vidarbha region of Maharashtra.

Maharashtra has five types of forests and each type represents a unique Eco-system.

1) Southern Tropical Semi-Evergreen Forests:

This type of forests is mostly seen on upper hill slope from 450 - 1050m above in the Western Ghats. The main species of plants found are kinjal, anjani, hirda, jambul, parjamun, mango, pisa, etc.

2) Southern Tropical Moist Deciduous Forests:

Two sub-types occur under this group.

a) Moist Teak bearing forests:

From commercial point of view these are important and valuable forests of the state. These forest are mainly confined to Project Tiger area in Melghat region of Amravati district, Chandrapur, Gadchiroli and Thane districtshaving species of trees like teak, ain, shisam, haldu, moha, bija, kalam, semal, bamboo etc.

b) Moist Mixed Deciduous Forests:

Teak is occasionally present and the evergreen component of species is larger than in case of Teak bearing forests. The main species found are bija, semal, behada, shisam, jambul, ain, bendara etc.

3) Southern Tropical Dry Deciduous Forests:

This type of forest occupies a major part of the state. This forest produce middle and small size timber while, the major species is teak. The sub-types are-

a) Dry Teak Bearing Forests:

Main species found is teak and other species are tiwas,khair, shivan, dhawada etc.

b) Dry Mixed Forests:

Teak is occasionnaly present and the evergreen component of species is larger than in case of teak bearing forests. The main species found are bija, semal, behada, shisum,jambul, ain, bendaraetc.

4) Southern Tropical Thorn Forests:

This type covers the forests of the low rainfall areas of Marathwada, Vidharbha, Khandesh and western Maharashtra. Most of the forests are heavily degraded due to low fertility coupled with low rainfall. The main species found are babul, hiwar, bor, palas, hingabet. These forests are full of Euphorbia and cassiascrub.

5) Littoral and Swamp Forests:

These forests occur along the creeks and littoral in Sindhudurg and Thane district. Though their comparative extent in the state is marginal, they are important for protection of seacoast and marine life. The typical mangrove species found in this area are Avincennia species and Rhizophora species etc.

7.8. QUESTIONS FOR SELF-STUDY:

1) What are the direct and indirect uses of forests?
2) Answer in brief the different types of forests in India.
3) Which are the five largest mangroves and swamp forests in India?
4) Give the other classifications of Indian forests.
5) How are the forests products useful to us?
6) Explain in brief the forests in Maharashtra.

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8

FORESTRY II

Unit Structure:

8.1. Deforestation

8.2. Causes of Deforestation

8.3. Consequences of Deforestation

8.4. Solutions to Deforestation

8.5. Social Forestry

8.6. Types of Social Forestry

8.7. Objectives of Social Forestry

8.8. Questions

8.1. DEFORESTATION:

India is not only famous for its diverse wildlife, architectural marvels and culture, but is also famous for its dense and vast forest cover. Variety of flora and fauna are benefited by the climate in India. Forest is the second largest land use in India other than agriculture. The National Forest Stipulates that 1/3 of area should be under forest or tree cover. But being a mega-bio diversity country, the nation possesses high level of endemism. The rising demand for forest based products and resultant deforestation and encroachment has led to a severe loss of natural resources and destruction of habitat.

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Deforestation is one of the major causes to the environmental degradation, which affects the small farmers, ranches, loggers and plantation companies. The expansion of cropped areas and pastures are a major source of deforestation. The term "Deforestation" means the complete long-term removal of tree cover.it occurs for many reasons- trees are cut down for sellingas fuel or timber, cleared land is used as pasture for livestock, plantations of commodities and settlements. The removal of

trees without sufficient reforestation has resulted in damage to habitat, loss of biodiversity and aridity. The climate is influenced by the lost forest cover and contributes to a loss of biodiversity. The economic activity of the state and country is adversely affected by siltation, flooding, soil degradation and reduced timber supply; in turn threaten the livelihood of the people.

Lack of forest management and deficient environmental lawsare some of the factors that allow deforestation to occur on a large scale. In many countries, deforestation occurs both naturally and human induced. Deforestation causes extinction of plant species, changes to climatic conditions, desertification, and displacement of populations.

8.2. CAUSES OF DEFORESTATION:

1) Shifting Cultivation: Shifting cultivation is another cause for deforestation. Shifting cultivation occurred due to poor fertility of soil. In this cultivation small patch of tropical forests is cleared, destroyed and burned for vegetation. Crops are grown as long as soil is productive. Then the land is abandoned and the cultivators move on to a fresh patch of land.

The abandoned land is allowed to lie as such for long periods. Due to which the regret of vegetation takes place and natural ecosystem is restored. Shifting cultivation thus worked in harmony with nature. In this method the soil is unable to regain its fertility before it is put to use again. This causes degradation of soil and failure of crops after crops. As they don't get crops, more and more land is cleared of forests and put to similar over exploitation. The overall result is that green forests are being gradually replaced by barren wasteland.

2) Expansion of Agriculture: The increasing demand for agricultural product has forced to bring more and more land under cultivation for which forests are destroyed, grasslands ploughed, uneven grounds leveled, marshlands drained and even land water is reclaimed. This expansion marks more ecological destruction. In tropical regions much of the mineral material is lodged in the plant biomass. The removal of trees takes away large part of nutrients. The soil becomes infertile and is unable to support farming for long duration.

3) Extension of Cultivation on Hill Slopes: Agriculture has always been concentrated on planes and floors of valleys. Butfarming on narrow flat steps cut one after another across the slope or terrace farming is an age-old practice. The increasing population and their growing necessities, have forced man to go up to the mountain slopes for cultivation. More and more mountain slopes are cleared of plants, steps carved out against many odds cultivation is attempted. But after few cropping seasons the productivity decreases.

4) Timber Harvesting: Timber is an important asset for the prosperity of the country. Commercial wood is found ready in national as well as international markets. Natural forests are being exploited due to logging or felling of forests trees for obtaining timber is an important cause

of deforestation. Live trees havingthick and straight trunk are cut filled and transported to commercial establishments. Large stretches of forests are destroyed and damaged in this process. The government, large companies oraffluent contractors enjoy the profits from timber trade. The local people get very little share in the benefits while axing their own resource base.

5) Fire Wood Collection: Wood is used as fuel for cooking and for providing heat in chilling winters by majority of rural populations as well as large number of people living in small towns and cities and developing countries. Fire wood collection contributes much to the depletion of forest cover. The more the forests are dense the more is the production of combustible material in the form of dead twigs, leaves, etc. There is hardly any need to cut live trees in dense forests. But in case of light wooded forests, a slow thinning of wood lands occur due to regular foraging or cutting of wood by the villagers due to high-pressure demands. The dead wood is actually manufactured, trees are axed, their barks are girdled and live trees become personal head loads to find their way to local markets.

6) Commercial Logging: Commercial logging supplies wood (meranti, teak, Mahagony and ebony) to the international markets. This commercial logging destroys trees as well as opening up forest for agriculture. Even cutting of trees for fire wood and building material, the heavy lopping of foliage for fodder and heavy grazing of saplings by domestic animals like goats.

7) Mining: Mining processes because environmental impacts like erosion, formation of sinkholes, and loss of biodiversity and contamination of soil, groundwater and surface water by chemicals disposed. To increase the available room for the storage of the created debris and soil, in some areas additional forest logging is done in the vicinity of mines. If the leakage of chemicals frommining processes is not controlled properly it affects the health of local population. The best example of pollution from mining activities is the coal fires, lasting for years or even decades, producing massive amounts of environmental damage.

8) Increase in population: With the increase in population the needs also increase and forests resources are utilized. Agricultural lands and settlements are created permanently by clearing forests to meet the demands of rapidly growing population.

9) Urbanization and Industrialization: Major amount of forests land are cut in order to promote industrialization and urbanization, as they need land to grow. As a result harmful effect is created on environment and forest ecological balance.

10) Construction of dam reservoirs: Large-scale devastation of forests takes place for building dams, which breaks the natural ecological balance of the region. As a result floods, droughts and landslides become a frequent phenomenon in such areas. Forests are the repositories of invaluable gifts of nature in the form of biodiversity. But by destroying

the forests we lose the species having marvelous or medicinal value even before knowing them. These storehouses of species that have evolved over millions of years are lost due to deforestation in a single stroke.

11) Forest fires: Forest fires may be natural or manmade, which causes huge forest loss.

12) Overgrazing: When plants are exposed to intensive grazing for extended periods of time or without sufficient recovery periods overgrazing occurs. This is caused by either livestock in poorly managed agricultural applications or by over populations of native or non-native wild animals. Overgrazing reduces the usefulness, productivity and biodiversity of the land and also is one cause of desertification and erosion. Overgrazing also spreads invasive species of non-native plants and of weeds.

13) Decreased Evapotranspiration: Deforestation contributes to decreased evaporation, transpiration, which lessens the atmospheric moisture. In some cases it affects precipitation levels downwind from the deforested areas. The water is not recycled to downwind forests, but is lost in runoff and returns directly to the oceans.

The degradation of forest ecosystem has also been traced to economic incentives that make forest conversion appear more profitable than forest conservation. Many important forest functions have no markets, and hence, no economic value that is readily apparent to the forest's owners or the communities that rely on forests for their wellbeing.

8.3. CONSEQUENCES OF DEFORESTATION:

Depending on the needs of the social group concerned, deforestation has made it possible for communities to be built. Forests make way for residential houses, office buildings and factories. Government is able to build roads to make trade and transport easier for the convenience of residents. Deforestation also means the conversion of forestland to productive land for agricultural uses for better and more abundant production of food and materials, which virtually eradicates periods of want and lack. From economic point of view deforestation has contributed much in giving many communities the opportunities to make positive changes in their times. Unfortunately the negative consequences of deforestation outweigh its positive effects.

1) Food Problems: The deforested area is not suitable for conservation. Most of the deforested area is actually unsuitable for long-term agricultural use like ranching and farming. As soon as the forest cover is removed the land rapidly degrades in quality by losing its fertility and arability. The soil in many deforested areas is not suitable for supporting annual crops. Most of the grasslands are also not productive compared to arable soils and therefore are unfit for long term cattle grazing.

2) Flooding: Deforestation results to watersheds that are no longer able sustain and regulate water flows from rivers and streams. The forest serves as cover against erosion. Trees absorb water and keep the amount of water in watersheds to amanageable level. As the trees are cut too much water results to downstream flooding causing great disasters in many parts. This results in the erosion of the fertile topsoil and is flooded in the low- lying areas.

Many coastal fisheries and coral reefs suffer due to the sedimentation deposited due to flooding. This results to negative effects in the economic viability of many businesses and fatalities inwildlife population.

3) Exposing soil to heat and rain: By clearing the tropical rain forests heavy rainfall and high sunlight quickly damage the topsoil in the forests. As a result forests will take much longer to regenerate and the land will not be available and suitable for agricultural use for quite some time.

4) Loss of Biodiversity: The most serious consequence of deforestation is the loss of biodiversity. Deforestation means the destruction and extinction of many species of plants and animals, many of them will remain unknown and their benefits will be left undiscovered.

5) Displacement of indigenous communities: Deforestation threatens the life and survival of some indigenous people and communities. Forests workers feel insecure due to loss of forests.

6) Extinction of Flora and Fauna: Flora and Fauna are accustomed to their habitat. Due to massive felling down of trees various species of plants and animals are lost. The animals lose their habitat and are forced to move from native location to new location. Some of them are even pushed to extinction as they find it difficult to adjust to the new habitats. Our world has lost many species of plants and animals in the last couple of decades.

7) Economic Loss : Frequent occurrence and strength of floods and droughts affect the economy of the country. Deforestation also counts to a loss of future markets for eco-tourism. It is to be understood that the value of forests is more when it is left standing than it could be worth when harvested.

8) Health Issues: The stress of environmental change may reduce resistance power in some species and may make them more susceptible to the effect of insects, pollution and diseases.

9) Increase in Global Warming: Trees play a major role in controlling global warming. The trees utilize the greenhouse gases, restoring the balance in the atmosphere. With constant deforestation the ratio of greenhouse gases in the atmosphere has increased, adding to our global warming woes.

10) Climate Change: Deforestation affects the climate in more than one ways. Trees release water vapor in the air, which iscompromised on with

the lac on trees. Trees provide the required shade that keeps the soil moist. This leads to the imbalance in the atmospheric temperature further making conditions difficult for the ecosystem. Loss of forest cover results in increase in the carbon dioxide concentration in the atmosphere and contributes to global warming. Deforestation leads to the extreme conditions of climate in nature.

8.4. SOLUTIONS ON DEFORESTATION:

Trees play a vital role in our life, but are being destroyed at an alarming rate. Trees are cut and burnt down for a number of reasons. Forest is logged to supply timber for wood and paper products, to clear land for crops, cattle and housing. Other causes include mining and oil exploitation, urbanization, acid rains and wildfires. Deforestation also contributes to air and water pollution, a loss of biodiversity, erosion and climatic disruption. According to the United Nation's Food and Agricultural Organization (FAO), the 33 million acres of forestland that are lost annually around the globe are responsible for 20% of human caused greenhouse gas emissions. So many of the choices we make throughout the day anywhere in the world may be we are shopping, eating, drinking water or even driving are powered by deforestation.

Here's what we can do about deforestation:

1) Plant a tree.
2) Go paperless.
3) Recycle and buy recycled products.
4) Look for Forest Stewardship Council (FSC) certification on wood and wood products.
5) Eat vegetarian meals as often as possible.

We can take one step further by making sure the choices wemake at home, at the store, at work, or anywhere else or doing any work don't contribute to the problem of deforestation. Lets make theplanet greener and healthier by devising effective solutions for deforestation.

Solutions to Deforestation:

A) Improved Methods of farming: For growing crops and rearing cattle trees, the land is to be cleared to carry out the agricultural operations and for grazing. Farmers should use new methods of farming to prevent clearing of land. This in turn will prevent the indiscriminate cutting down of trees.

B) Cyclic Agriculture: In this type of agriculture land is used for cultivation till the soil loses its fertility and then it is abandoned. After few years the natural vegetation makes the soil fertile again. The time span in which the soil remains barren can be utilized for cattle grazing. This helps in preserving forests as trees are not cut and land cleared for creating farmlands for farming.

C) Crop Rotation: In crop rotation farming, the same plot of land is utilized to grow seasonal crops, one after the other. Cutting down trees to clear new land for cultivation is prevented by this method. Italso increases the productivity of soil.

D) Use of High-Yielding Variety Seeds (HYV Seeds): HYV seeds are often drought and insect resistant. The production is more by utilization of small piece of land. This restricts cutting and clearingof forests land for cultivation.

E) Hydroponics: It is a special technique of growing plants in water (without soil) containing dissolved nutrients.

G) Another solution is to curb the felling of trees, by employing a series of rules and laws to govern it.

H) Clear cutting of forests must be banned. It is a practical solution and is very feasible.

I) Land cleared of its tree cover for urban settlements should be urged to plant trees in the vicinity and replace the older trees that were cut by planting young trees.

Trees are being planted under several initiatives every year, but they still don't match the number of trees we have already lost.

International Programs:

REDD- Reducing Emissions from Deforestation and Forest Degradation is a program initiated to provide monetary assistance to developing countries facing the problem of deforestation. The monetary assistance provided is utilized to roll back or limit deforestation and stop practices that harm the environment.

Initiative by FSC- Forest Stewardship Council is a non-profit organization aiming at minimizing the impact of commercial logging on forests around the world. It provides certifications to timber logs and products that have originated from sustainable forests and ensures that logging does not exceed capacities of forests, thus allowing long-term sustainable harvesting. A small way to help FSCto achieve its mission of saving forests is to buy wood products withthe FSC trademark.

National Initiative-As a national initiative, the government of the country needs to impose strict rules to put stop to deforestation and take strict action against offenders. Initiative should be taken to plant trees both in urban and rural areas. In urban area barren land should be used for planting. Measures should be taken to compensate for the tree loss. Forests should be guarded and logging practices should be watched on. Government should allow special incentives to organizations taking part in afforestation. Tax cuts should be granted to corporations to get them actively interested in reforestation.

Scarcity of water will disturb the entire ecosystem and trees cannot grow in areas deficient in water supply. So watermanagement programs should ensure that water wastage is reduced and help promote the growth of trees in water scarcity areas.

8.5. SOCIAL FORESTRY:

The concept of social forestry aimed at the production of fuelwood, fodder and small timber for local communities. It calls for a grass root initiative in which local communities have to be both the implementers and beneficiaries of the program. The forest department and external agencies would only provide consultancy and support. The central focus of this concept is the active involvement of local people.

The need for social forestry scheme was felt as India has a dominant rural population depending largely on fuel wood and other biomass for their cooking and heating. The demand for fuel wood will not decrease but the area under forest will reduce further due to the growing population and increasing human activities. So thegovernment is trying to increase forests areas that are close to human settlements. The degradation over the years due to human activities needed to be afforested. So trees were to be planted in and around agricultural fields. Plantation of trees along railway lines and roadsides, river and canal banks were carried out. Trees were planted in village common land, government wasteland, and panchayat land. Social forestry scheme was initiated in India to increase fuel availability in rural areas and to prevent soil erosion.

The idea behind the social forestry scheme was to create and make available forests on any land that was available and not used for any other purpose. This scheme was implemented with the help of society for meeting the needs of society through the forests created and pressure on natural forest is thereby reduced. It can be stated that social forestry is of the people by the people and for thepeople.

Social Forestry means the management and protection of forests and afforestation on barren lands with the purpose of helping in the environmental, social and rural development. The term, social forestry was first used in India in 1976 by the National Commission on Agriculture, Government of India. It was then that India embarked upon a social forestry project with the aim of taking the pressure off currently existing forests by planting trees on all unused and fallow land.

Involvement of common people:

Social forestry also aims at raising plantations by the common man so as to meet the growing demand for timber, fuel wood, fodder, etc. so as to reduce pressure on traditional forests areas. This concept has existed through the centuries all over the country, but now it is being given a new character. Introducing this scheme, the government formally recognized the local community's rights to forest resources, and is now encouraging rural people's participation in the management of natural resources. The government has involved community participation through the social

forestry scheme, as part of a drive towards afforestation and rehabilitating the degraded forest and common lands. Plant a tree challenge movement has been started to invoke a sense among people to come and participate and take every occasion to plant a tree, as it is their responsibility.

8.6. TYPES OF SOCIAL FORESTRY:

Social Forestry Scheme can be categorized into groups- farm forestry, community forestry, extension forestry and agroforestry.

A) Farm Forestry: Commercial and Non-Commercial farm forestry is being promoted in one form or the other in almost all the countries where social forestry program have been taken up. In many areas this tradition of growing trees on the farmland already exists. Individual farmers are being encouraged to plant trees on their own farmland to meet the domestic needs of the family. At present non-commercial farm forestry is the main thrust of most of the social forestry projects in the country. It is not always necessarythat the farmer grows trees for fuel wood, but many a times they grow trees without any economic motive. They may plant trees to provide shade for the agricultural crops, as wind shelters, for soil conservation or to use wasteland. Farm forestry is another name for Agroforestry; a part of social forestry.

B) Community Forestry: It is also called as Rural Forestry. This is another scheme taken up under the social forestry program. It is the raising of trees on community land and not on private land as in farm forestry. This program aims to provide for the entire community and not for any individual. The government provides seedlings, fertilizer but the community has to take responsibility of protecting the trees. Some communities manage the plantations sensibly and in a sustainable manner for the benefit of the village. While, some took advantage and sold the timber for a short-term individual profit. It is very easy to exploit the common land, as it is everyone's land. Large-scale planting of eucalyptus plant is done in India, as it is a fast growing exotic plant, making it a part of the drive to reforest the subcontinent, and create an adequate supply of timber for rural communities.

C) Extension Forestry: Extension forestry is nothing but planting of trees on the roadside, canals and railways and planting on wasteland. Extension means increasing the boundaries of forests. Under this project lots of trees were planted and there has been creation of wood lots in the village common lands, government wastelands and panchayat lands.

D) Urban Forestry: The aim of urban forestry is to bring trees to the door of the urban people. It lays emphasis on the aesthetic development of urban areas. Flower and fruit trees of different varieties having different seasons of bearing fruits and flowers and other ornamental varieties of plants are planted along roadsides, canal banks, near village, towns and cities. Urban forestry also includes beautification of houses, roads and vacant lands. It also aims at creation of tree reserves in towns and cities.

E) Agroforestry: In agroforestry, Silvi cultural practices are combined with agricultural crops like leguminous crop, along with orchard farming and livestock ranching on the same piece of land. In short we can say agroforestry as growing of forest trees along with agricultural crop on the same piece of land.

In scientific way agroforestry is defined as a sustainable land use system that maintains or increase the total yield by combining food crop together with forest tree and livestock ranching on the same unit of land, using management practices that takes care of the social and cultural characteristics of the local people and the economic and ecological condition of the local area.

8.7. OBJECTIVES OF SOCIAL FORESTRY:

Social forestry schemes have been started throughout India making a difference in forest cover and benefiting rural and urban communities. The main objectives of the scheme are:

1) To improve the environment for protecting agriculture from adverse climatic factors.
2) Increase the natural beauty of the landscape; create recreational forests for the benefit of rural and urban population.
3) Increase the supply of wood fuel for domestic use, small timber for rural housing, agricultural implements, fodder for livestock and minor forest produce for local industries and ensure the release of cow dung that can be used as manure.
4) To increase production of fruits and add to the potential food resources for the country and to provide shade and ornamental trees for the landscape.
5) Land rehabilitation. Help to conserve soil and water and to maintain ecological balance by enhancing biomass.
6) To help in the creation of shelterbelts around agricultural fields so as to increase their productivity.
7) Provide employment opportunities and thus increase the family income and help to alleviate poverty.
8) Help to raise the standard of living and quality of life of the rural and the urban people. To meet the recreational needs of the rural population and to include the consciousness and love of trees amongst the people and to foster the spirit of co-operative enterprises.
9) To provide a favorable environment to the tribals to help them preserve their cultural identity as they are intimately related to forests.
10) Social forestry aims at popularizing the planting and tending of trees in farms, villages, municipal and public lands for their economic, protective and aesthetic value.
11) To relieve pressure on reserved forests.

Mission:

a) Afforestation of abandoned barren lands and mined areas.

b) To carry out a need based and time bound program of afforestation with special emphasis on fuel wood and fodder development on all degraded and denuded lands/forests.

c) Afforestation on under-utilized lands under state, institutional or private ownership.

d) Green belts in urban/industrial areas.

e) Linear strip plantation of fast growing species on sides of public roads, rivers, streams and irrigation canals.

f) Farm forestry in the form of raising rows of trees on bund or boundaries of fields and individual trees in private agricultural land as well as creation of wind breaks round a farm or orchard by raising one or two lines of trees.

g) Shelter belt for the purpose of shelter from wind and sun covering areas larger than a single farm on a planned pattern.

h) Raise flowering trees and shrubs mainly to serve as recreationforests for the urban and rural population.

i) People's participation involving women and young people in conservation of forests, wildlife and environment.

j) Creating environmental awareness and celebrating Vanamahotsava, environment day, wildlife week, etc.

Advantages of Social Forestry:

a) Provides fruit, fuel, fodder and timber.

b) Conserves soil against erosive forces and improve the soilfertility.

c) Helps in increased rainfall through transpiration.

d) Reduces surface run-off of water and sedimentation of reservoirs, rivers, streams etc.

e) It facilitates the infiltration of water and helps in the maintenanceof the ground water table.

f) It helps in bringing the deep-seated nutrients to the soil surface and helps in environmental conservation by absorbing carbon dioxide and releasing oxygen by the plants in the atmosphere.

g) Noise pollution is controlled.

h) Cottage industries can be developed in large numbers.

Reasons for Failure of Social Forestry Program:

A) The main objective of social forestry program was totally ignored. It did not fulfill the need of rural households the access to fuel wood and fodder for domestic consumption. Women and children had to spend their maximum time to collect the fuel wood.

B) Involvement of landless people in the afforestation program was a failure. In fact it aggravated poverty and unemployment in rural areas.

C) It did not involve women who collect fuel for their daily need. It did not involve the tribals who are deeply interested in theprotection and promotion of forests.

D) Cutting of trees and cattle browsing and grazing could not be stopped.

E) The bigger farmers were the only beneficiaries of the social forestry program.

F) Last but not the least in social forestry program hardy exotic species of trees like Eucalyptus was planted on large scale on farmlands and public lands. This lowered the ground water tableand also reduced the growth and colonization of native plant species.

This ambitious program was not successful in our country as it lacked community involvement, wrong selection of tree species tobe planted and lack of effective control over cattle browsing and grazing, and cutting trees. The pressure on natural forests couldnot be minimized.

8.8. QUESTIONS FOR SELF-STUDY:

1) What is deforestation and give its causes?

2) What are the consequences of deforestation?

3) Suggest solutions to deforestation.

4) What is social forestry and give its types?

5) What is the mission of social forestry?

6) Write short notes on:

a) Different programs to stop deforestation

b) Objectives of social forestry

c) Advantages of social forestry

d) Reasons for the failure of social forestry

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9

FORESTRY III

Unit Structure:

9.1. Significance of Agroforestry

9.2. Scope of Agroforestry

9.3. Features of Agroforestry

9.4. Advantages of Agroforestry

9.5. Traditional Agroforestry Systems in India

9.6. Limitations of Agroforestry

9.7. Highlights of Agroforestry Policy

9.8. Forest Management Activities in Maharashtra

9.9. Summary

9.10. Questions

9.1. SIGNIFICANCE OF AGROFORESTRY :

Agroforestry is a dynamic, ecologically based, natural resource management system. It is focused on meeting the economic, environmental and social needs of people on their private lands. Agroforestry at farm level is a set of practices that provide strong economic and conservation incentives for landowner adoption. It provides a different land use option, compared with traditional arable and forestry systems. To effectively utilize the available resources agroforestry makes use of the complimentarily relationships between trees and crops. Agroforestry supports the environment. The plot or land used remains productive for the farmer and generates continuous revenue, which is not feasible in arable land. Agroforestry allows diversification of farm activities andmakes better use of environmental resources. Due to increase in population of human and cattle population there is an increase in demand of food; fodder etc. so there is slight scope to increase the area under cultivation.

9.1.1.DEFINITIONS OF AGROFORESTRY:

"Agroforestry is a collective name for land-use systems and technologies in which woody perennials including trees, shrubs, bamboos etc. are deliberately combined on the same land- management unit with the herbaceous crops or animals either in some form of spatial arrangement or temporal sequence."

"A sustainable management system for land that increases overall production, combines agricultural crops, tree crops and forest plants and /or animals simultaneously/or sequentially and applies management practices that are compatible with the cultural patterns of local population."

"Agroforestry is a dynamic, ecologically based, natural resource management practice that, through the integration of treeson farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits."

Agroforestry system includes both ecological and socio- economic interactions between different components. It implies that

- Agroforestry normally involves two or more species of plants (or plants and animals), at least one of which is a woody perennial.

Agroforestry system always has two or more outputs.

The cycle of agroforestry system is always more than one year. The simplest agroforestry system is structurally, functionally, and socio-economically more complex than a mono-cropping system.

Agroforestry implies management of at least one plant species for forage, an annual or perennial crop production. The final definition of agroforestry can be as follows:-

"Agroforestry is a form of multiple cropping which satisfies three basic conditions- (i) there exists at least two plant species that interact biologically, (ii) at least one of the plant species is a woody perennial and (iii) at least one of the plant species is managed for forage, annual or perennial crop production."

In simple terms agroforestry can be described as " an efficient land-use system where trees or shrubs are grown with arable crops, seeking positive interactions in enhancing productivityon the sustainable basis.

Agriculture and forestry technologies are combined by agroforestry to create more integrated, diverse, profitable, productive, healthy and sustainable land-use systems. The important agroforestry practices are windbreaks, riparian forest buffers, alley cropping, silvi pasture and forest farming.

9.2. SCOPE OF AGROFORESTRY:

Agroforestry applies to private agricultural and forests lands and communities that are highly disturbed, human dominated land- use systems. Highly erodible, flood-prone, economically marginal and environmentally sensitive lands are targeted. Goal of agroforestry is to restore essential process needed for ecosystem health and sustainability, rather than to restore natural ecosystem. Agroforestry provides strong incentives for adoption of conservationpractices and alternative land uses, and supports a collaborative watershed analysis approach to management

of landscapes containing mixed ownerships, vegetation types and land uses.

9.2.1.Benefits of Agroforestry:

When trees are combined with food crops on cropland farms they yield certain environmental benefits – ecological and social benefits.

Ecological Benefits-

1) Reduction of pressure on forests.
2) Better protection of ecological systems.
3) Deep rooted trees on site provide more efficient recycling.
4) Constant addition and decomposition of litter-fall helps in the increase in soil nutrients and soil structure.
5) Combination of mulching and shading improves the microclimate, such as lowering of soil surface temperature and reduction of evaporation of soil moisture.
6) When trees are combined with food crops on cropland farms they yield certain erosion through impending effect of tree roots and stems of these processes. It also reduces surface run-off and nutrient leaching and soil.

Economic Benefits:

Agroforestry systems on farmlands are economically beneficial to the farmer, the community, the region or the nation. They are-

1) Increase in farm level income due to improved and sustained productivity.
2) Increase in the maintenance of outputs of food, fuel-wood,fodder, fertilizer and timber.
3) Reduction in incidence of total crop failure, common to single – cropping or monoculture system.

Social Benefits:

Social benefits occur from increase in crop and tree product yields and in the sustainability of these products. The benefits are –

1) Due to increased quality and diversity of food outputs there is an improvement in nutrition and health of the people.
2) Sustained employment and higher incomes have improved therural standard of living.
3) Elimination of the need to shift sites of farm activities havestabilized and improved the upland communities.

9.2.2.Possible impacts of Agroforestry:

a) By increasing the production of agroforestry products for home consumption and market poverty has been controlled by anincrease in income.

b) Women farmer and other less-advantaged rural residents whose rights to land were insecure were empowered through better negotiations.

c) By providing fuel wood grown on farms, pressure on forest and deforestation was reduced.

d) Food security was achieved by restoring farm soil fertility for food crops and production of fruits, vegetables, nuts and edible oils.

e) Improving soil health of the farm through ameliorated micro- climate and nutrition level.

f) Farmers buffering capacity has increased against the effects of global climate change on farm tree crops and tree cover.

g) Accessibility to medicinal trees for cure of common and complex diseases was augmented.

9.3. FEATURES OF AGROFORESTRY :

Agroforestry practices are intentional systematic combinations of trees with crops and/or livestock that involve intensive management of the interactions between the components as an integrated agro ecosystem. Following criteria are to be satisfied for a land use practice for Agroforestry:

Intentional:

Trees, crops and/or animals are combined, intentionally designed and managed as a whole unit, rather than as individual elements that may occur in close proximity but are controlled separately.

Intensive:

Agroforestry practices are intensively managed to maintain their productive and protective functions. The practices involve annual operations like cultivation and fertilization.

Interactive:

The biological and physical interactions between the tree, crop and animal components are actively manipulated in agroforestry management. The goal is to enhance the production ofmore than one harvestable component at a time, by providing conservation benefits such as non-point source water pollution control or wildlife habitat.

Integrated:

The tree, crop and/or animal components are structurally and functionally combined into a single, integrated management unit. Integration may be horizontal or vertical, and above or below ground, which utilizes more of productive capacity of the land and helps balance economic production with resource conservation.

9.4. ADVANTAGES OF AGROFORESTRY FROM THREE DIFFERENT PERSPECTIVES ARE AS FOLLOWS:-

From the Agricultural Perspective:

1) Intercrops and animals are protected by the trees that have a windbreak effect. They provide shelter from the sun, rain, wind, soil erosion and stimulating soil micro flora and micro fauna.

2) By recycling some of the leached or drained nutrients by the deep roots of the trees. Tree litter and the residue of the trees enrich the soil organic matter.

3) Diversification of the activities of arable farmers by building-up of an inheritance of multi-purpose trees, with continuous revenue from the farm.

4) Agroforestry is an alternative to full restoration of arable land, permitting the continuation of arable activity on land whose arable potential is conserved.

5) Agroforestry plantations on arable land allow the development of a quality wood resource that compliments.

6) Combining the interest of farmer and the farm there is possibilityof increased remuneration for the arable farmer for the trees.

7) In silvi pastoral plots, fodder units are available at differentperiods compared to full cropped plots by extending the grazing calendar.

From the Forestry Perspective:

1) Wide spacing of trees can enhance the biomass growth of trees.Due to the presence of the intercrops there is a large reduction in the maintenance costs of plantation.

2) Due to arable intercropping activity there is a guaranteed follow-up and care of trees is taken.

3) As the trees are not subjected to cycles of competition and thinning there is improvement in the quality of wood produced.

4) Agroforestry plantations on arable land allow the development of a quality wood resource that complements and are little used in

forestry, but are of high value and can be grown in agroforestry systems. For example: service trees, cherry trees, maple trees, tulip trees, etc.

From the Environmental Perspective:

1) Improvement to the development of natural resources:

The separate production obtained by an arable-forest separate cropping pattern on the same area of land is less than the total wood and arable production from an agroforestry plot. This is the result from the stimulation of complementary between trees and crops on agroforestry plots. Thus harvested crops or pasture replace the weeds that is spontaneously present in young forestryplantations.

2) Agroforestry plots have innovative landscaping potential thatwould improve the public image of farmers to society. Creating original landscapes are attractive, open and favor recreational activities. This can be done in sparsely wooded areas where, plots are developed by planting arable land. It can also be done in very heavily wooded areas where, plots are developed by thinning the existing forests.

3) Better Control of Cultivated areas of land:

The agroforestry plots contribute to diminishing the cultivatedarea of land and better control of land can be gained by substituting for arable plots. But the intensification of environmental resources used by agroforestry systems does not result in more crop products.

4) Soil and water in particular in sensitive areas are protected.

5) Improvement of Biodiversity by the Edge Effects:

It permits a synergistic improvement, by favoring the habitat of game. The promising way is the integrated protection of crops by their association with trees chosen to stimulate the hyper-parasite population of crops.

6) Counteract the greenhouse effect:

Constitution of an effective system for carbon sequestration, by combining the maintenance of the stock of organic material in the soil, and the superimposition of a net fixing wooded layer counteract the greenhouse effect.

7) The above favorable characteristics are coherent with the many objectives of the laws guiding agriculture and forestry, as they are with the directing principles of the Common Agricultural Policy.

9.5. TRADITIONAL AGROFORESTRY SYSTEMS IN INDIA:

Agroforestry is wide spread in all ecological andgeographical regions of India. The agroforestry systems vary intheir structural complexity and

species diversity, their productive and protective attributes and their socio-economic dimensions. The systems range from apparently simple forms of shifting cultivation to complex home-gardens, from systems involving sparse stands of trees on farm lands to high-density complex multistoried homesteads of humid lowlands, from systems in which trees play a predominantly service role (shelter belts) to those in which they provide main salable products (intercropping with plantations crops).

1) Shifting Cultivation (slashes and burn system):

This farming system is followed in north-eastern high rainfall areas in which land under natural vegetation is cleared by slash and burn method cropped with common arable crops for a few years and then left unattended when natural vegetation regenerates. The fallow period has drastically reduced due to increasing population pressure which, has resulted in the degeneration of soil causing serious soil erosion depleting soil fertility resulting in low productivity. Intercropping under or between fast-growing trees in a fallow phase is one of the approaches while the second approach advocated is the farming system approach base on watershed management as an alternative to shifting cultivation.

2) Taungya System:

It is like an organized and systematically managed shifting cultivation. It involves cultivation of crops in forests or forests trees in crop fields. In southern India, the system is called 'kumari'. It is practiced in areas with an assured annual rainfall of over 1200- 1500mm.

3) Home-gardens/ homesteads cultivation:

This is an old-age practice in coastal states. A homestead is a operational farm unit in which a number of crops including tree crops are grown with livestock, poultry and /or fish production. The main purpose is to meet the routine basic needs of the farmer. There is a great variation in the intensity of trees, species and cropsbased on the size of holding, micro-climate and the needs of the people residing in homesteads. Domestic animals and poultry are the main components of homesteads. Multitude of crop species in the homesteads helps to satisfy primary needs of the farmer such as food, fuel, fodder, timber and cash. This system helps in checking soil erosion, environmental health and conserve biodiversity. In spite of high intensity of cropping it helps to conserve fertility by nutrient cycling or organic manuring or mulching and increased microbial activity in the rhizosphere of crops.

4) Plantation based Agroforestry systems:

The scope for integrative practices involving plant associations in these commercial plantations is limited, except during the early phases of plantation when some intercropping is feasible. The aim of this commercial production is having a single commodity. Modern plantation crops like rubber, coffee, poplar, eucalyptus, oil-palm and coconut represent a well-managed and profitable stable land use activity in tropics.

5) Scattered trees on Farm Lands:

This system of growing agricultural crops under scattered trees on farmlands is old. The species diversity in this system is very much related to ecology. The species diversity and system complexity increases with the increase in rainfall. There is a proliferation of more diverse multistoried home-gardens in humid areas and less diverse, two tiered canopy of configurations in drier areas. Trees are grown scattered in agricultural fields for shade, fodder, fuel, wood, fruit, vegetables and medicinal uses.

6) Trees on Farm-Boundaries:

Trees grown in agricultural fields are also often and usually grown on farm-boundaries. At many places succulents like agave and many cactus plants are grown as live fence. Many of theboundary plantations also help as shelterbelts and windbreaks,particularly in fruit orchards.

7) Wood Lots:

In many parts of the country, farmers grow trees in separate blocks as wood lots along with agricultural fields. This practice is expanding fast due to shortage of fuel-wood and demand of bamboo poles or pulp wood industry.

8) Systems for soil conservation or amelioration:

The deep and narrow gullies are best controlled, by putting them to permanent vegetation after closure to grazing. Afforestation with suitable tree species will help in stabilizing ravines and gullies and checking their spread. Due to increase in population these wood lots have decreased at a faster rate.

9) Shelter Belt:

The arid regions throughout the year experience very high wind velocity. So farmers build shelter belts (kana bundi) by using either dead wood or local vegetation to check the wind velocity within safer limits. This permanent vegetation helps accumulation of sand near them, which is again spread in the field. This system helps increase crop yields along the lines.

10) Trees on Rangelands:

Trees are planted on common community grazing lands. In tropics coconut is the most common tree on pasturelands. Cattles are raised usually grazing on these pastures. But in some cases special fodder plants including legumes are also cultivated.

9.6. LIMITATIONS OF AGROFORESTRY

There are certain disadvantages of agroforestry-

From the Environmental Aspects:

a) There is possible competition of trees with food crops for space, sunlight, moisture and nutrients resulting in the reduction of foodcrop yield.

b) Food crops can be damaged or destroyed during tree harvest operation.

c) The trees that serve as host to certain insects and pests can be harmful to food crops.

d) Rapid regeneration by prolific trees may displace food cropsand take over entire fields.

Socioeconomic Aspects:

a) Competition between the food crops and tree crops can cause aggregate yields to be lower than those of a single crop.

b) Farmers resist displacing of food crops with trees, especiallywhere land is scarce.

c) More labor input is required causing scarcity at times in otherfarm activities.

d) The trees require longer period to grow to maturity and gain economic value.

e) Compared to single-crop farm agroforestry is more complex, it isless understood and more difficult to apply.

But through skillful management practices the above aspects can be controlled. It is easy to adopt the following strategies either all or some.

i) The tree species selected should be deep rooted to absorb moisture and nutrients from the surface layer of soil.

ii) The legume trees selected should have small or light crowns for sufficient sunlight to reach the food crop for photosynthesis.

iii) To reduce the competitive effect on the food crops tree spacing should be farther apart.

Agroforestry is seen as a solution to meet the challenges of food, nutrition, energy, employment and environment security. Earlier efforts to promote agroforestry have failed. But the National Food Security Act, 2013 made it a legal obligation for the government to provide food to more than 80 crore of the country's population. A need was felt to increase agricultural production in a sustainable manner. Agroforestry can also help in reducing unemployment.

9.7. HIGHLIGHTS OF AGROFORESTRY POLICY

1) Maintenance of green cover on farmlands throughout the year, enhancement of ecosystem through carbon storage, mitigate climate change effects, prevent deforestation, improve biodiversity, provide cleaner water and reduce land erosion.

2) To include trees in farming systems and manage them in rural landscapes to enhance productivity, profitability, diversity and ecosystem sustainability.

3) To augment energy capacity through biomass, biodiesel, ethanol, bio-char and biogas production.

4) Significant potential to provide employment to rural and urban population through production, industrial application and value addition ventures.

5) Only alternative to meet the target of increasing forest cover is to reach from present level of 20% to 33%.

6) Creating awareness about the importance of trees is necessary through schools, other educational institutions, seminars, stage shows, office campaigns to create a basic understanding of the need for afforestation and make them aware how cutting of trees is detrimental to life.

7) It is important that people understand the need of trees, and substitute wood fuel with biomass, biofuel, biogas etc.

8) Using recycled paper products can be of help to reduce the need for cutting trees and preserve forests.

9) Initiatives for planting trees should be taken at individual level and group level. Group initiative to plant trees on hills, fertile patches of land in the outskirts of the city or on riversides can surely be of help. Planting a tree or two in one's garden or an area around one's school or workplace also can make up for the loss of trees in the past and promote a healthier environment.

9.8. FOREST MANAGEMENT ACTIVITIES IN MAHARASHTRA:

A) Forest Management Activities are carried through various institutional Mechanisms. They are as follows-

1) Joint Forest Management (JFM)-

It is a concept of developing partnerships between fringe forest communities and the forest department on the basis of mutual trust and jointly defined roles and responsibilities with regard to forest protection and development. The community level institutional involvement in various forest protection and development activities, have made promising impact on the biophysical and socio-economic environment of the forest

on the fringes of these villages. The effective and meaningful involvement of local communities in sustainable forest management is the main approach to solve the longstanding problems of deforestation and land degradation.

2) Forest Nurseries:

Maharashtra Forest Department (MFD) has established a large network of permanent and temporary forest nurseries leading to production of seedlings of several forestry species representing various agro-ecological zones of the state. Besides the MFD Public Forestry Development Corporation of Maharashtra (FDCM), Nagpur and the Directorate of Social Forestry, Pune have established nurseries to meet their planting stock requirement.

3) Supply of poles and Firewood:

The Government supplies poles and firewood at subsidized rates to the local villagers to stop the tendency of illicit felling of trees in forests.

4) Creation of Forest-based Institutions:

Samanvit Gram Vanikaran Samridhi Yojana (SGVSY) anumbrella scheme integrating all ongoing centrally sponsored schemes (CSSs) related to afforestation was launched through a new autonomous institution called the Forest Development Agency (FDA) with JFM as the mainstay.

5) Maharashtra Van Sanshodhan Sanstha (MVSS):

Located at Chandrapur, has got research centres at Lohara near chandrapur, tadgaon near Bhimaragarh. Lohara institution is a pioneer in developing the techniques of teak bud grafting and developing a prototype machine for teak seed treatment.

6) Afforestation by Forest Development Corporation of Maharashtra (FDCM):

Various afforestation projects are undertaken on turnkey basis. It helps in the process of creation of vegetative cover, which in turn benefits the entrepreneur and the society at large. FDCM have major activities lie afforestation in mining areas, urban plantation and beautification projects, industrial plantations, thinning in teak plantations, harvesting in government forests.

7) Sant Tukaram Vanagram Yojana:

With a view to create awareness regarding the importance of forest and wildlife, to protect from illegal tree cutting, encroachment etc., Sant Tukaram Vanagram Yojana was launched.

8) Protected Area Network in Maharashtra:

Protected areas declared under the Wildlife Protection Act 1972, include National Parks, Wildlife Sanctuaries, Tiger Reserves, Biosphere Reserves,

Conservation Reserves and CommunityReserves. Various species of flora and fauna along with the ecosystem is conserved due to the network of protected areas.

9) Protection of Mangrove covers:

After direction given by Hon. High Court in 2005 certain patches of mangroves were declared as forests areas in Maharashtra and this has helped to protect important mangrove cover in Maharashtra.

B) Community and Community Organizations:

Community participation is a very important aspect in implementation of resource management programs. Communities take various initiatives for conservation – like Sacred Groves, whichare forest patches protected for religious or cultural reasons. Many of these groves are at the origin of rivers, helping in water conservation and also protect rare varieties of plants and animals. The examples of community's role in forests conservation are Chipko Movement and Bishnois in Rajasthan. The successachieved by this protest led to similar protests in other parts of the country. These movements were successful because the people loved nature and main aim was to protect the environment, wildlife and plants. The basic philosophy followed was that all living things have a right to survive and share all resources. The Chipko movement and Bishnois have proved that human lives are a small price to pay to protect the wildlife and the forests around them.

C) Individuals and Private Bodies:

Individual efforts by people have led to conservation of tree cover in a particular area. Successful restoration activities on many acres of land for the revival of forests ecosystem have been carried out by many individuals and has helped to maintain green cover ofthe area.

D) Effective Conservation:

Some more measures would help in conserving forest ecosystem in addition to current measures taken to conserve forests.

Conservation at Governmental Level:

a) Before making the 'Development Plan', a thorough study of the environmental issues and important aspects with respect to environment in a particular city / area should be done, which in turn will help in detailing out the area details and then planning further development in tune with environment. For example an area with garden should specify the inhabiting species and other details considering local environment. Development plan shouldbe as such that it does not disturb the habitat and wildlife therein.

b) Use of native trees in the plantation program will help to revive the natural ecosystem in an area.

c) The Compensatory Afforestation should not only be plantation but a process of starting a new ecosystem as a whole.

d) Sustainable harvesting should be kept in mind while making economic use of forests.

e) Strict enforcement of rules and regulations is necessary. The revenue earned from eco-tourism, visits to nature parks, forests and protected areas should be used for conservation of resources.

f) People participation should be encouraged in afforestation and conservation schemes within towns, cities and villages in an eco-friendly manner.

9.9. SUMMARY:

A comprehensive program of afforestation is the urgent needof the hour. But success can only be achieved only through the co- operation of the local people. Population explosion should be controlled for which intensive efforts should be made on a war- footing. Increased population means more space for housing, fuel wood, timber, etc. Community and individuals can be more effective in conservation of resources. People should be alert to destructive activities, report any illegal activity to the forest department and press. People should acquaint with the laws, rules and orders issued by the government. Likeminded people should be in touch and organized. Awareness should be created about the existence and value of national parks and sanctuaries. Pressurize the authorities to implement the forest and wildlife laws and rules to protect green areas. Legal action should be taken if necessary and if possible through Public Interest Litigation (PIL). Community can create public pressure to change rules, laws and procedures when necessary. Do not litter in forest area. Ecologically sensitive public transport and bicycle tracks should be used. People should participate in preservation of greenery, by planting, watering and caring for indigenous plant species. Alternative things like wise use of paper, electricity, recycling of paper, reuse of wooden furniture, use of particle board / eco-board for furniture, avoid using greeting cards and send e-greetings, avoid use of gift wrappers or reuse them, etc.

9.10. QUESTIONS:

1) Give the significance, scope and benefits of agroforestry.
2) Explain in short the features of agroforestry.
3) Give the advantages of agroforestry.
4) What are the traditional agroforestry systems in India?
5) What are the limitations of agroforestry?
6) Give the highlights of agroforestry policy.
7) Explain the Forest Management Activities in Maharashtra.

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