T.Y.B.A.

RURAL DEVELOPMENT

Paper-VI

APPLIED AGRICULTURE

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August 2016, T.Y.B.A. Rural Development, Paper-VI, Applied Agriculture

Published by : Incharge Director
Institute of Distance and Open Learning ,
University of Mumbai,
Vidyanagari, Mumbai - 400 098.

DTP Composed : Ashwini Arts
Gurukripa Chawl, M.C. Chagla Marg, Bamanwada,
Vile Parle (E), Mumbai - 400 099.

Printed by :

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APPLIED AGRICULTURE

Unit Structure :

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 areas people 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 countries 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 short basic 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.

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 countries economy stronger. Applied agriculture will help the marginal farmers, small farmers, landless agricultural laborers, 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.

Inorder 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, processing industries were started.

Green Revolution, White Revolution, Yellow Revolution, Blue Revolution 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 social and 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 word Horticulture 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 are 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 provide 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 -

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 green revolution 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 has varied 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 a new 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 the nutrient 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.India is 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 was difficult 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 beecolonies, 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 is an 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 the production 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 annual production.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 made it 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, flavours, fragrances and 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, fuelwood, 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 realised that deforestation threatened not only the ecology but their livelihood in a 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, are 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 drayers in addition to supplying

animals, milk, meat, eggs, wool and hides. Domestic animals or live stock 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.

8) 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.

9) 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.

10) 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 of food. 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 widely eaten 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.

11) 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 of living of rural people and overall change can be brought out.

12) 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 tested in the lab. A record of the 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.

13) 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, rabi 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.

14) Agricultural Scientist and science

Agricultural scientist are needed to do research in agriculture to 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.

15) 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 depends on agriculture and is the main source of income. The contribution of agriculture 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 the inputs 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 social and 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 and applied science is to use pure science for practical human purpose.All the above factors are included in scope of applied agriculture. 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

2

HORTICULTURE - I

Unit Structure :

2.0 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.

2.1 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 to the growing of plants in a field or garden.

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 the potential 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. It offers a wide range of options to the farmers for crop diversification and also provides ample scope for sustaining large number of Agro-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, 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 and flourish as this sector has attracted entrepreneurs for taking up horticulture as a commercial venture.

2.2 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 family budget on purchase of fruits.
ii) Fruit tree farming reduces soil erosion, silting tanks and air pollution.
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.

2.3 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.

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, 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.

2.4 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 and pomegranate.

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 high evaporative 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.

2.5 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 result 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 Fruit Crops-

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, hails, light. Soil has factors like physical condition of the soil and its fertility, nature of sub-soil, its drainage condition, temperature texture and its consumption.

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 have his 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 else must 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 both ways 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.

2.6 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 plant tall 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 be mechanically 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 close spacing 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 a 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.

2.7 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 shelterbelts:
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 in rows. 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 the prevailing 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.

2.8 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 owners residence and layout quarters should be located fairly 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 source of 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 a good 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 trees further 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 be 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.

2.9 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 is the selection of 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?

3

HORTICULTURE - II

Unit Structure :

3.0 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 be 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.

3.1 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 equilateral triangle. 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 is doubled 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.

3.2 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 pits or 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 plants are not preferable. Plants selected should be within one year of grafting or budding and one year old plant with a height of 2 to3 feet is 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.

3.3 PROPAGATION METHODS IN PLANTS

Plant propagation is defined as " Controlled reproduction of a plant by man in order to perpetuate a selected individual, or group of 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 olour 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 are multiplied in the first instance through sexual propagation although subsequent fixing of heterocyst is effected through vegetative propagation. E.g. sapota (cricket ball x oval) andratna mango (alphanso x neelam).
7) Roots stock are 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 to type of seed. (except in Apomixes)
2) When Progenies are not true type, they become inferior because in the commercial orchard, it is necessary o 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 after extraction. Many varieties are seedless.
4) Seeds lose its viability in short period.

3.3.1 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 extracted only from ripe fruit. Seeds gathered from immature fruit may not

germinate under favorable conditions and may loose viability more quickly 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 sometime depending on the type of plant. Most of the plant seeds retain their viability for a longer 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.

3.3.2 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 achieved by –

a) Placing the seeds between two sand papers, one stationed and other revolving.
b) Passing seeds through the machine that scratches the surface of 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 germination of 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.

3.3.3 Plant Propagation by Cutting

Cutting is a method of asexual propagation. In this method a portion of any vegetative part such as stem, ieaf, 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 are as 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, pahadigulab, India cork tree.

3.3.4 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 photosynthates 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 in short 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 is separated 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 this method 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 enclosed in 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 soil surface in the dormant season. The dormant buds will produce new shoots 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 shoot grows into a U shape with roots developing at the bend.

3.3.5 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.

3.3.6 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 stem that 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 leables. 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 or slender 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 of a 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 of horizontally 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.

3.4 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 an orchard.
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?
11) Give the difference between layering and cutting.
12) Explain plant propagation by specialized structures.

4

HORTICULTURE III

Unit Structure :

4.0 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 the stock 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.

4.0.1 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 union and 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 of branch 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

4.1 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.

4.1.1 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 method except 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 within 2-3 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 tied firmly 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 is done. The thick barked tree thicker than 1 cm and in active stage are 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 as usually 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.

4.2 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 and Uttaranchal 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.

4.2.1 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.

4.3 NATIONAL LEVEL

a) General Council:

The Mission will have a General Council (GC) at the National level under the Chairmanship of the Union Agriculture Minister. The council 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.

4.4 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. State and Sub-State level structures will be evolved keeping in view the need for getting adequate returns for the produce of the farmers and 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 close coordination with Technical Support Group, State Agriculture Universities (SAU) and ICAR institutions and oversee its implementation.

b) Receive funds from the National Mission Authority, the State Government and other sources fro carrying on the missions activities, 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, 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 an other institutions having technical expertise.

4.4.1 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.

4.5 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 the National level EC indicating approval by SLEC, on the web site exclusively created for the purpose. The same will be replaced after its approval by national level EC. Attempt will be made to display the position regarding the AAP on line.

4.6 MISSION FOR INTEGRATED DEVELOPMENT OF HORTICULTURE (MIDH) SCHEMES-

NHM-

National Horticulture Mission (NHM) is one of the sub schemes 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 interventions being 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 Integrated Development 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 Field functionaries in the North Eastern Region.CIH now one of the sub schemes of MIDH. However, CIH is not implementing any schemes directly.

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-

4.7 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 the Indian context it is also known as “JaivikKrishi”.

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 of nature'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 cover is more important and must be preserved.

4.8 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 vegetable's as they are a good source of vitamins and minerals. Fruits and vegetables also contain pectin, cellulose that stimulate 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 alieviation 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, 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.

4.9 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

5

FORESTRY – I

Unit Structure :

5.0 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.

5.1 INTRODUCTION :

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 of its geography, history and culture but also of its diversity of its natural ecosystem. TheIndian 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, thorn forests, subtropical pine forests in the lower zone and temperate 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 5,081 square 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 planetearth. 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 the forests. 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.

5.2 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 to split and have low moisture content to dry faster. Some of the wood is 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 acooling 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 help in binding the sand and stabilize 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 help in balancing the carbon dioxide and oxygen in the atmosphere and regulate 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 velocity of winds and slow down the process of evaporation.

5.3 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. In the 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, slopes of 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 in the 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 between 15°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° and 22.5°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 during the general rainy season. The main trees grown in this 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 wet temperate 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 Rajasthan and 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 are 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 Tamil Nadu. 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.

5.4 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 against indiscriminate 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.

5.5 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 used for 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 particle boards.

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, polo sticks, 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 are 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 are 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.

5.6 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 cover most 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 occupy 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, bendara etc.

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 cassia scrub.

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.

5.7 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.

6

FORESTRY II

Unit Structure :

6.0 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.

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 selling as 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 laws are 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.

6.1 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 lay 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. But farming 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 having thick 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 or affluent 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 cause environmental impacts like erosion, formation of sinkholes, 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 from mining 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 phenomena in such areas. Forests are the repositories of invaluable gifts of nature in the formof 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 evapo 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.

6.2 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 degrade 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 a manageable 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 in wildlife 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 green house gases, restoring the balance in the atmosphere. With constant deforestation the ratio of green house 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 is compromised 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.

6.3- 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 are 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 we make at home, at the store, at work, or anywhere else or doing any work don't contribute to the problem of deforestation. Lets make the planet 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 looses 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. It also 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 clearing of 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 FSC to achieve its mission of saving forests is to buy wood products with the 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 water management programs should ensure that water wastage is reduced and help promote the growth of trees in water scarcity areas.

6.4 SOCIAL FORESTRY:

The concept of social forestry aimed at the production of fuel wood, 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 the government 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. Treeswere 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 the people.

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 communities 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.

6.5 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 necessary that 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 live stock 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.

6.6 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 jhum 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 recreation forests 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 soil fertility.

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 maintenance of 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 the protection 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 were planted on large scale on farmlands and public lands. This lowered the ground water table and 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 to be planted and lack of effective control over cattle browsing and grazing, and cutting trees. The pressure on natural forests could not be minimized.

6.7 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

7

FORESTRY III

Unit Structure :

7.0 SIGNIFICANCE OF AGROFORESTRY :

Agroforestry is a social forestry and its purpose is sustainable development. 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 and makes 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.

7.0.1 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 trees on 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 productivity on 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.

7.1 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 conservation practices and alternative land uses, and supports a collaborative watershed analysis approach to management of landscapes containing mixed ownerships, vegetation types and land uses.

7.1.1 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 the rural standard of living.
3) Elimination of the need to shift sites of farm activities have stabilized and improved the upland communities.

7.1.2 Possible impacts of Agroforestry:

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

7.2 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 of more 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.

7.3 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 possibility of increased remuneration for the arable farmer for the trees.
7) In silvi pastoral plots, fodder units are available at different periods 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 are spontaneously present in young forestry plantations.

2) Agroforestry plots have innovative landscaping potential that would 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 cultivated area 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 do 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.

7.4 TRADITIONAL AGROFORESTRY SYSTEMS IN INDIA:

Agroforestry is wide spread in all ecological and geographical regions of India. The agroforestry systems vary in their 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 (slash 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 crops based 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 the boundary 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.

7.5 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 food crop 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 crops and 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, especially where land is scarce.

c) More labor input is required causing scarcity at times in other farm 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 is less 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.

7.6 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.

7.7 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) an umbrella 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 Community Reserves. Various species of flora and fauna along with the ecosystem is conserved due to the network of protected areas.

9) Protection of Mangrove cover:

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, which are 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 communities role in forests conservation are Chipko Movement and Bishnois in Rajasthan. The success achieved 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 of the 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 through 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 should be 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.

7.8 SUMMARY :

A comprehensive program of afforestation is the urgent need of 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.

7.9 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.

8

ANIMAL HUSBANDRY

Unit Structure :

8.0 OBJECTIVES

a) To understand the concept and scope of animal husbandry.
b) To understand the importance of animal husbandry in rural development.
c) To know the various government schemes for the development of animal husbandry.
d) To understand the role of women in animal husbandry.

8.1 INTRODUCTION

Ever since the beginning of civilization, humans have depended on animals for many requirements like food, clothing, labor, security, and other things. Humans have consistently taken efforts to improve the breeds of domesticated animals to make them more useful. The development of animal species of desirable qualities, through creating better breeds, has been an important human achievement.

In India agriculture has been practiced for thousands of years along with rearing of animals for meat, milk and clothing. For this the humans had to gain knowledge of animal species that could be domesticated to ensure maximum productivity. This helped them to be familiar with the animal habits, assist with births and to treat

them during ailments and diseases. In India a large number of farmers depend on animal rearing for their livelihood. Animals mainly bullocks are the major source of power for both farmers and drayers besides providing milk, meat, eggs, wool and hides. Livestock, meat, eggs, milk, hides etc. are the major products for the farmers. Livestock are just not mere animals for farmers they treat them as their companions. Farmers, farms and farm animals together are a good farming eco-system in India.

Livestock has been an integral part of India's agricultural and rural economy since time immemorial. It has been supplying energy for crop production in various agricultural operations, in terms of draught power and organic manure. They in turn derive their own energy requirements from crop byproducts and its residue. New inventions in bio-chemical and mechanical technologies recently have weakened the synchronization between livestock and crops.Livestock contribute over 1/4th of the agricultural GDP (Gross Domestic Product) and engage about 9% of the agricultural labor force in rural India. Now-a-days livestock are valued as source of food, but in recent years livestock production and productivity has decreased at a considerable rate. In 12th five-year plans livestock sector is expected to emerge as an engine of agricultural growth and demand for animal food products. Significant barrier to the commercialization of livestock production is the under-developed livestock market.

8.2 CONCEPT OF ANIMAL HUSBANDRY

Animal Husbandry is one of the most important occupations of the farmers in India. Animal husbandry is the science of looking after and breeding animals-used in agriculture, providing animal products, animals for research purposes or as domestic pets. The branch of science dealing with the study of various breeds of domesticated animals and their management for obtaining better products and services from is known as Animal Husbandry. It is called Livestock Management, when it corporates the study of proper utilization of economically important domestic animals.

Animal husbandry covers a wide range of activities like caring and grooming of animals, livestock farming, accommodation and hygiene and including other disciplines – agriculture, veterinary science and genetics. Animal husbandry includes domestication of animals for milk, meat, eggs, wool, skin and hides, etc. and use them for draught and transportation. India has about 500 species of animals, but only a few are domesticated for different uses. This includes animals like bullocks,cow, buffalo, goat, sheep, pig, camel, horse, donkey, mule, oxen, yak, etc.

Animal husbandry plays an important role in the Indian rural economy. Many of the practices involved in animal husbandry come from being brought up on farms wherein a large number of animals are reared and raised. This is seen mainly in the rural areas. In India children are taught at an early age how to take care of the animals their parents have raised so that they also can take over farms and ranches as adults. In developed countries there are programs that help the children learn to take care and how to raise the animals. In many parts of the world, people are practicing animal husbandry as farmers, sheepherders, ranchers or simply taking care of large groups of livestock.

In India dairying is regarded as an instrument for social and economic development. The country's milk is supplied through millions of small producers, who are dispersed in the rural areas. Income from crop production is seasonal, but dairying provides a stable income all the year round. It is an important economic incentive for the small farmer. The farmers maintain an average herd of one or two milch animals, comprising of cows and/or buffaloes. As dairying requires small land base and ample labor is available farmers are encouraged to practice dairying as an subsidiary occupation. Now a large number of modern milk and milk product factories have been established. The organized dairies in India have been successfully engaged in the routine commercial production of pasteurized bottled milk for Indian dairy products.

Sheep rearing is another branch of livestock rearing. Sheep with its multi-facet utility for wool, meat, milk, skins and manure, form an important component of rural economy. It provides a dependable source of income to the shepherds through sale of wool and animals.

Goat rearing in India is a very important component in dry land farming system. Goat is known as 'Poor man's cow'. 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. Goats can efficiently survive on available shrubs and trees in adverse harsh environment in low fertility lands where no other crop can be grown. 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.

Pig farming is adapted to both diversified and intensified agriculture. pigs convert inedible feeds, forages, and certain grain byproducts obtained from mills, meat by products, damaged feeds and garbage into valuable nutrition. The faeces of pig is useful in maintaining soil fertility. With a small investment on building and equipment, proper feeding and sound disease control program the farmer can profitably utilize his time and labor in this subsidiary occupation.

Rabbit rearing or farming is also a part of livestock rearing. Rabbits are basically reared for meat, fur and wool. They have great potential to convert the absolute feed into quality products for human beings. Rabbits can be fed with forage, low grain diet that is largely non-competitive with human food. Its meat is highly nutritious, tasty and excellent in quality and is rich in protein, low in fat, cholesterol and sodium. They are both suited for both small scale and large scale commercial production.

Poultry farming is the raising of domesticated birds like chickens, ducks, turkeys, and geese for the purpose of meat or eggs for food. Poultry are farmed in great numbers with chickens being the most numerous. More than 50 billion chickens are raised annually as a source of food (both meat and egg). Poultry keeping, in India, has for a long time remained a rural cottage enterprise. The common village hen receives very little attention and care. As a result its productivity also is low. But now poultry is one of the fastest growing segments of the agricultural sector. The production of eggs and broilers has rose at a rate of 8-10% annually. As a result, India was the fifth largest egg producer and the eighteenth largest producer of broilers in the world.

8.3 SCOPE OF ANIMAL HUSBANDRY

Livestock plays an important role in generating income and employment in the rural areas. Besides assisting in crop production it also contributes to household income. It utilizes human resources in a better way as it provides full time occupation at the location itself along with providing balanced nutrition in the form of milk, egg, meat and farm power. Animal husbandry plays a major role in providing self-employment. A large section of women are engaged in this. Livestock products also are very good export earners.

Pursuing career in animal husbandry can be either continuing the family farming business or to obtain academic qualifications in specialist topic. Those who take this subject at undergraduate level would be less interested in caring for livestock and more likely they would specialize in degrees in veterinary medicine, pharmacy (specializing in animals), or join in companies manufacturing products for livestock. Some people who raise livestock may join classes in animal husbandry to learn how to dock tails, make use of new technology and techniques. Besides agriculture animal husbandry is employed in raising of animals for scientific and medical research. For testing and taking trials of new drugs animals are often required in large numbers. So they are raised and kept in identical conditions, so that valid comparisons can be made between different groups. The animals used for testing should be healthy as it involves carefully regulating a

number of different factors like temperature, ventilation, lighting and sanitation, as well as food and water. For this a detailed knowledge of the specific species is essential.

Diverse and changing role of livestock :

Livestock is nothing but a capital asset that is produced in the past and contributes to future product output. Investment in livestock raises the production in the farms through extension of land area that can be used, diversification of the productive activity on the farm and by raising livestock value of output and as a result total agricultural production per hectare increases. Livestock production is categorized into grassland-based, mixed farming and landless production system. The landless production system is mainly responsible for the growth in supply of meat production. The landless livestock production system is a labor using technology. Mixed crop livestock production system is important, as it is the source of the bulk ruminant livestock production. In this the livestock is fed on crop by-products, other plant material, contributes draught power, manure, additional sources of food and also income, savings and emergencies.

Institutional changes :

Institutions constitute the formal laws and rules. Along with the informal norms of behavior and conventions, which governs access to resources, transactions between individuals and organizations group activity. Livestock are generally privately owned, but for land and other natural resources, private freehold tenure is the only one alternative. Institutional change may have acritical influence on economic development. Transaction costs are low in a traditional village society. It is based more on relational contracting. Historical stagnation and contemporary under-development in developing countries lack effective institutions. Open access to pasture land may lead to over-grazing and degradation. Private or community ownership is preferred. The farm household is a unit of production and consumption. Labor hire for livestock is generally based on long-term contracts to avoid problems of uncertainty, performance monitoring and asset specificity. Animal health services are important in reducing losses due to animal disease. Technological change plays a key role in agricultural development. Development of market infrastructure and institutions is essential for economic growth.

8.4 GROWTH OF MARKETS AND PROMOTING LIVESTOCK DEVELOPMENT

Agricultural markets have increased and expanded with the growth of international trade. Trade in livestock production is said to be increasing but it represents only a small proportion of total value.

Now in recent years the scene has changed in developing countries as they have started exporting goods rather than importing them. Milk and poultry meat are one of the exported items in the country.

The demand for increased livestock production is increasing, and as a result the livestock is contributing to the incomes and welfare of the rural poor. For new livestock business; additional physical and or financial capital is necessary. But later on the replacements can be home bred. Human capital having the knowledge of husbandry and skills is needed. Technological innovations should be appropriate to the resource base. Access to market outlets and input delivery systems is also necessary. There is a need for improvement in the areas of water supplies and draught relief, technical improvements in animal health, nutrition and production system. There is vast scope in the livestock business for import substitution and saving foreign exchange. Improvement in the traditional backyard systems is necessary along with the development of an institutional framework. This can promote equitable contracts between commercial processors and smallholder producers and joint action by small holders in establishing processing and marketing facilities. Institutional development requires strengthening of rural roads and communications, property rights and contractual agreements, and organizations that provide credit, animal health services and other inputs. Research has been done in animal and veterinary public health, forage crops and the utilization of crop by-products, improved animal husbandry and production systems and breeding, but it is not up to the extent that is needed in the rural areas. Socio economic research is needed in the existing production systems, institutions for land tenure, credit, labor hire, input delivery and product marketing.

The importance of livestock and their products is increasing as consumer demand expands with population growth and rising incomes. This growth in consumption of livestock and its product is reflected in improvements in the average human nutritional status due to intake of animal protein. Livestock products are costly than the staple crop products, so diets in most developing countries generally include lower levels of intake of animal products than the developed and industrialized countries. However wherever domestic production of livestock has failed to keep pace with the growing demand so imports of livestock products have increased considerably. Livestock play an important role in contributing to rural livelihoods, employment and poverty relief. In mixed and integrated farming systems livestock contribute to both intensification and diversification of income streams. It is not only an additional income but also increase crop yields. Draught animals may also contribute to expansion of crop production by saving in labor requirements. Livestock may provide a reserve against

emergencies, while in many societies it also serve social and cultural function. It also acts as a quantitative measure of family status.

8.5 ROLE OF ANIMAL HUSBANDRY IN HUMAN WELFARE MANAGEMENT

Animal Husbandry is a branch of agriculture dealing with the care and management of livestock. It deals with the feeding, breeding, housing and health care of livestock to gain maximum benefits. Livestock refers to farm animals (cow, buffalo, sheep, goat, pig, horse, camel, poultry, fisheries, etc.) that are reared by humans for commercial purpose or for recreation purposes.

Livestock has been used by humans for animal products like - milk, eggs, meat, wool, silk, honey etc.

The word Husbandry means the management of domestic affair. It is used in connection with proper feeding, breeding, health-care, housing etc. more than 70% of the world livestock population is in India and china, but it contributes to only 25% of the world farm produce. As a result new techniques have to be used to improve quality and productivity along with the old traditional methods of animal breeding and care.

Role of Animal Husbandry in Human Welfare-

a) Dairy Products-Milch animals can be used as a source of milk and dairy products like yogurt, cheese, butter, ghee, paneer, ice-cream etc.
b) Meat- it is a good source of animal dietary protein and energy.
c) Fiber- Livestock produce s a variety of fiber. Sheep and goat produce wool, deer and sheep for leather.
d) Fertilizer- The dung of these animals can be used as an excellent manure and can be spread in the fields to increase the crop yields. Cow dung is also used to plaster the walls and for flooring also in rural areas. Cow dung cakes are used as fuel foe cooking and other domestic purpose. Bones of animals are also used as fertilizers.
e) Labor- Prior to steam power the only source of non-human labor were the livestock. Animals such as bullocks, horses, donkey, yak were used for mechanical energy. Still in many parts of the world they are used now also for operation like ploughing fields, transporting goods and many other functions.
f) Land Management- Animals are grazed sometimes as a way to control weeds and undergrowth.

Management of Farm and Farm Animals :

Management is the art and science of combining ideas, providing facilities, different processes, materials and labor to produce and give services or market a worthwhile product successfully in the market. Some of the management procedures are as follows.

Dairy Farm Management :

It includes the management of animals for milk and its products for human consumption. Cow, buffalo, goat and sheep are the generally preferred animals for dairy products. The milk yield from cow and buffalo is more than goat and sheep. Cow milk contains carotene, which gives yellow color to the milk. Ghee from cow milk fed on green fodder is more yellow than fed on dry fodder. Buffalo milk does not contain carotene. Dairy management deals with the processes and systems that increase yield and improve quality of milk. They are as follows-

1) Four essential methods for livestock improvement are breeding, weeding, feeding, and heeding :

a) The animals both male and female selected for breeding should be of superior quality.

b) Uneconomic animals should be prevented from reproducing is the aim of weeding.

c) Feeding is an important aspect of livestock improvement. Each animal should be given balanced ration.

d) Heeding means paying attention to the animals. It implies good animal management and general supervision including housing care and maintenance of proper cleanliness and hygiene.

2) Health Care :

According to World Health Organization (WHO) definition of health is “Health is the state of complete physical, mental and social well-being and not merely the absence of disease.” A healthy animal eats, drinks and sleeps well regularly. So good health is also important.

3) Resistance to diseases :

The animal is protected from diseases if looked well and also it can develop resistance to diseases.

4) Suitable Environmental conditions :

Sufficient light, water, air, suitable temperature, adequate ventilation and well drainage housing system should be provided.

5) Regular Inspections :

Regular visit by veterinary doctor is necessary. It requires regular inspections and the records should be maintained properly. In short we can say the productive potentialities of livestock are controlled by three principle factors- i) genetic makeup ii) nutrition iii) environment including the climatic conditions.

8.6 LIVESTOCK EXTENSION

In India agriculture is a state responsibility, the implementation of livestock policy is also at state level eventhough the policy has been established at the national level. The state policies addressing critical needs in dairy development have not been yet clearly defined across the country. Even though some of the developed states have a well-defined policy, they have problems in implementing the policies.

The hurdle in the effective implementation of the livestock policy is the lack of clarity between the roles of state Livestock Development Agency and the State Department of Animal Husbandry, Dairying and Fisheries. The other problem is that of availability of funds to implement the livestock activities. There is a need to emphasize the importance of dairying to small holders incomes, so that they direct more resources towards dairy development. Extension of knowledge, technology and service to the grass-root level is of paramount importance for the growth of the sector. Extension services for livestock have been a non starter severely hampering its growth compared to the crop sector. Animal husbandry is considered as a subsidiary occupation. The extension format and methodology developed for crop production are considered to take care of the livestock sector. This is not true because both the central and state government have given extension low priority. Only 1% of the total budget is allocated for the extension activities of this sector.

In the recent past, the livestock sector in India has emerged as an important source of agricultural growth and rural development. The change in the production systems, increased participation of women category, technological advances in breeding, feeding, management and health require distinct extension approaches and set-up. Doorstep delivery of services in artificial insemination, immunization, health coverage, credit facilities, market coverage is essential. Emphasis should be laid on wider dissemination of information through intensive contact and electronic media.

8.7 STRATEGIES AND PROGRAMS FOR 12TH PLAN

Utmost priority should be given to develop appropriate livestock extension system, so that its potential for agricultural growth and rural development can be fully exploited. Various technical, advisory and financial needs of different livestock production systems and species need a differentiated approach of providing extension and input services by knowledgeable and skilled workers. Special KVKs should be established that would lay emphasis on various livestock activities with the support of para-vets, NGOs and other development organizations. They should also support education to farmers and up gradation of skills of para-vets and field guides. The shortage of technical manpower for work in the field should be addressed appropriately. Public-Private-Partnership (PPP) in extension should be encouraged and made partners in PPP mode for effective management of services. A major program on livestock extension, delivery of services and women empowerment should be initiated to enhance the efficiency of production.

The veterinary and animal science service is a highly specialized area. It involves management and health care of the livestock and poultry, prevention of diseases, disease diagnosis, meat and food inspection, including milk and milk products, quarantine, animal welfare, feed formulation and testing, dissemination of technologies besides administration and management. The scope for export of livestock and hygienically produced livestock products has increased due to Globalization and World Trade Agreements (WTA). Shortage of manpower is a major concern. Veterinary infrastructure in general is poor and inadequate and there is need for strengthening it.

8.8 WOMEN AND LIVESTOCK

The central and state governments economic policies have enhanced and sustained agricultural growth. They were not able to address adequately the deeply entrenched economic and social inequalities in the Indian societies. Women are the custodian and producers of agricultural products and translate these products into food and nutrition of their households. Women spend most of the income sources on the education and nutrition of their children.

Growing population, rising income and rapid urbanization are the reasons for rising in the demand for livestock production. Globalization of agricultural food markets has exposed the livestock producers to global competition. This has transformed the national and global market for generating sectoral and national competitive advantage. It has created conditions that compel and enable

sectoral decision-makers to creatively utilize the opportunities to establish competitive advantage not only at farm level, but also at industry levels. Due to this India is leading in global livestock product market through sustained and all-round improvements in quality and efficiency. Participation of women in the growth and modernization of the livestock sector would need to promote gender sensitive institutional, legal and technological change in turn promoting productivity, excellence and competitive advantage.

Livestock production in India is largely in the hands of women folk. Most of the animal farming activities like fodder collection, feeding, watering and health care, management, milking and household level processing, value addition and marketing is performed by women. Livestock are important for the livelihood culture of women. Women have limited alternative opportunities for employment. As women have little resources to improve animal productivity it is difficult to manage risk and buy good quality animals for productivity enhancement. The under-privileged group of women should be helped to earn better and grow out of subsistence by giving them knowledge of appropriate technology, skills, market linkages, information and service delivery systems.

As there is inequity in the ownership of productive assets i.e. land and livestock and despite the women's considerable involvement and contribution to the livestock production, the gender inequalities do not allow them access to technologies, credit, information, inputs and services.

The rapidly increasing livestock product demand has created opportunities for women empowerment. Appropriate policies and institutional arrangements would help women in harnessing the objectives.

8.9 STRATEGIES AND PROGRAMS

Major approach and efforts should as such that they should enhance women's access to livestock assets so as to enable them to avail benefits of various livestock development programs and policies. Women self-help groups or women livestock producers association can be involved to avail credit for securing livestock and inputs, insurance to manage risks and input and services to improve animal productivity. The procedural requirements to avail policy benefits should be relaxed for women livestock keepers. They should also be provided additional incentives in terms of subsidies on interests and insurance premium.

Special programs should be initiated for developing women entrepreneurship along the livestock value chain. This must include

the production, processing and marketing so that they are able to face challenges that come in the production and marketing of livestock. As women are closely associated with the animals, they have better understanding and knowledge of the animal behavior in respect of reproduction, feeding, symptomatic changes in animal health and their response to external factors. Enhancement of women's skill in various aspects animal breeding, health, feed and nutrition, management and marketing is necessary. Women entrepreneurship should be developed in rearing of quality calves and heifers and marketing.

Dairy Co-operatives, Agri-Business and Marketing firms should register more women members or suppliers of dairy products. As the production systems are highly internalized based mainly on farm and family resources, it is necessary to boost animal productivity and income of the women. For this, there is a need for appropriation of technologies and improve animal health and nutrition through appropriate training programs, extension programs. This can enhance their capacity in clean livestock production and livestock management to improve resilience of livestock to climate change.

Social entrepreneurship approach should be adopted at village level specially in the ecologically fragile areas. Social engineering is more necessary than technical expertize to develop common property resources. There is need for improvement of animals that would survive well with the ecological fragile environment along with the empowerment of women. To enhance the effectiveness of women-oriented livestock development programs, there is a need to correct gender bias in veterinary education, research and service delivery education.

Centrally Sponsored Projects :

Livestock Health in rural areas.

National Project for cattle and buffalo Breeding.

Assistance for Modernization of Slaughter Houses and Carcass Utilization Plants.

Assistance to States for Feed and Fodder Development.

Livestock Insurance.

Establishment / Modernization of Rural Slaughter Houses.

Livestock Census.

Integrated Sample Survey Scheme for Estimation of Major Livestock Products.

Directorate of Animal Health (National Program for Prevention of Animal Diseases).

Central Cattle Breeding Farms.

Central Mini-kit Testing Program on Fodder Crops.

Central Poultry Development Organization.

Regional Stations For Forage Production & Demonstration.

Central Herd Registration Scheme.

8.10 SUMMARY

Livestock have been an integral component of India's agricultural and rural economy since time immemorial, supplying energy for crop production in terms of draught power and organic manure, and in turn deriving their own energy requirements from crop byproducts and residues. The advances in bio-chemical and mechanical technologies, however, have weakened the synergy between livestock and crops. Livestock are now more valued as source of food and contribute over one-fourth to the agricultural gross domestic product and engage about 9% of the agricultural labor force. The livestock sector has been growing faster than crop sector; however, in recent years, the growth both in livestock production and productivity has decelerated considerably. Livestock sector is expected to emerge as an engine of agricultural growth in the 12th plan and beyond in view of rapid growth in demand for animal food products. Achieving growth rate of 5-6%, however, would require addressing challenges of shortage of feed and fodder and frequent occurrence of some deadly diseases. The sector has remained under-invested; and neglected by the financial and extension institutions. Livestock markets are under-developed, which is a significant barrier to the commercialization of livestock production. Besides, the sector will also come under significant pressure of increasing globalization of agri-food markets.

8.11 QUESTIONS FOR SELF-STUDY:

1) What is the concept of animal husbandry?
2) Write in brief the scope for animal husbandry.
3) Explain the growth of markets and promotion of livestock development.
4) What is the role of animal husbandry in human welfare management?
5) Write short notes on:
   a) Livestock extension
   b) Strategies and programs
   c) Strategies and programs for 12^{th} plan
   d) Women and Livestock

9

DAIRY FARMING

Unit Structure

9.0 OBJECTIVES

1) To know the benefits of dairy farming.
2) To know the different breeds of cattle.
3) To learn to take care of milch animals.
4) TO know the factors affecting breeding efficiency.

9.1 INTRODUCTION

Dairy farming was traditionally a family business. But today it has grown to a large extent to an organized dairy industry with technological specializations in every step of the processes. Tremendous growth in dairy farming equipment is seen and it helps modern dairy farms to manage thousands of dairy cows and buffaloes. Many of the dairy farms in the villages still manage and run organic dairy farms and supply the milk to get processed by large companies and then sell to the retail outlets. To give maximum profit to the firms the best approach is to create and run a sustainable dairy farm. It also takes care of the effects of dairy farms on environments and animals for a longer period.

India is the largest milk producer of the world and milk has been marked as the number one farm commodity. The white revolution had made spectacular landmarks in the Indian milk production scenario. Rural prosperity by dairy farming was the need

of the hour. Today livestock production has taken a new turn by venturing itself on commercial basis. Judicious balanced feeding round the year is the reason behind the higher production potential of the crossbred animals and its economic sustainability. The major constraint in animal production at present is the chronic shortage of feed coupled with the poor quality fodder. In the recent system of intensive livestock production an increase in the concentrate feeding has increased the milk production cost and substantially decreased the profits of farmers. The increasing cost of feed ingredients and its seasonal variability has added to the gravity of the situation. Green fodder is essential component of feed for the high yielding milch animals as the desired level of milk production depend on it. The quality of herbage based animal feed and fodder is responsible for the sustainability of dairy industry in India.

9.2 BENEFITS OF DAIRY FARMING

There are many benefits of starting dairy business. The main importance and benefits of dairy farming are as follows:-

As dairy farming is a traditional business there is no need to worry about marketing your products. As dairy product is active all the year round, you can easily sell your products all over the country. Dairy farming is eco-friendly as it doesn't pollute the environment. Highly skilled labor is not required for dairy farming business. With the help of family labor you can easily setup small-scale dairy farm. Dairy farming provides great business opportunities to the educated unemployed young generation. Maximum production is ensured by, proper planning and management. The climate and environment of India is suitable for various highly productive native Indian and foreign breeds.

Commercial and small-scale dairy farming in India plays an important role in the total milk production and Indian economy. Most of the dairy farmers in India raise animals on small scale by traditional methods, as they are not aware of the modern farming methods and improved dairy farming techniques. Due to this some farmers are loosing their investment and not getting benefit. Almost all regions of India are suitable for setting up dairy farming business. Maximum production with profit from dairy farming business can be ensured if there is proper business plan, well managed and taken care.

Advantages of Dairy farming :

While starting dairy farming businessit is mandatory to know the advantages of dairy farming business system. Milk is the primary source of calcium mineral and nutrients for people.

1) As dairy industry is not totally reliant on rainfall, development is possible even on days when climate is very hot and dry.
2) Intake of dairy foods is increasing by both vegetarians and non-vegetarians.
3) The amount of milk that has been marketed has never gone down and even though the provider has surpassed the need, the price has remained the same.
4) Promotion of milk is very easy, compared to the items from other sectors. Costs of promotion is very low for any dairy and there is no need for unique stores for milk.
5) Dairy agriculture is the only industry where earnings are assured in 30 days.

Problems of Dairy Farming in India

The main limitations of dairy farming in India are as follows:

Most of the farmers are not serious about total expenditure and profit from this business. Value of the green fodder is not calculated and counted which they grow with the crop in their fields. High infrastructure and feeding cost is the main constraint of dairy farming business.

Most of the farmers are not conscious about the breeding process of the animals depend up on various factors, due to lack of proper publicity and public announcement by the government. They are unaware that animal breeding is a biological phenomenon and getting expected milk production depends on proper breeding process.

9.3 SELECTION OF DAIRY CATTLE

The first and most important step adopted in dairy farming is the proper selection of dairy cattle. Proper identification of animals and to keep records is very essential. Cross breed animals with exotic inheritance is preferred. In cross breeds, 50% of the native germplasm is helpful to retain the adaptability, heat tolerance and disease resistance traits of local animals. The best policy adopted is maintaining animals sustainable to the situation. Animals brought from different agro-climatic conditions cause many problems, as they cannot adjust to the new environment easily. So as far as possible the animals should be purchased from similar environmental conditions.

Selection of dairy breeds:

Cows-

Selecting a calf in calf show, a cow in a cattle show by judging is an art. A dairy farming should build up his own herd by

breeding his own herd. The guidelines to select a dairy cow are as follows:

1) Animals should be purchased during the months of October and November.
2) Animal purchased from a cattle fair should be selected based upon its breed characters and milk producing ability.
3) Organized farms reveal's the complete history of animal as they maintain history sheet or pedigree sheet.
4) A cow should allow anybody to milk, and should be docile.
5) The maximum yields by dairy cows are noticed during the first five lactations. Generally selection should be carried out during first or second lactation.
6) Maximum yield is noticed till 90 days after calving.
7) There successive complete milking has to be done and an average of it will give a fair idea regarding production by a particular animal.

Characteristics of high yielding dairy cows :

a) Animal should have wedge shaped appearance of the body.
b) Attractive individuality with feminity, vigour, harmonious blending parts, impressive style and carriage.
c) The breed should have bright eyes with lean neck.
d) The udder should be well attached to the abdomen.
e) There should be a good network of blood vessels in the skin of the udder.
f) All four quarters of the udder should be well demarcated with well placed teats.

9.4 Breeds of Cows

There are many native and highly productive foreign breeds available. Cows and buffaloes together can be raised in separate rows under the same shed. Cow's milk has low fat than the buffalo's milk. For profitable commercial dairy production the popular and common buffalo milch breeds are Murrah, surti, Mehasani, Jaffrabadi, Badhawari etc. Gir, Sahiwal, Red Sindhi, Tharparkar are popular cow breeds. The highly productive foreign breeds like HolsteinFreisian, Brown swiss, Jersey etc. All these breeds are suitable for Indian climate.

Breeds of Cows :

Gir-This breed is also known as Bhadawari, Desan, Gujarati, Kathiawari, Sorthi and Surati. Originated in Gir forests of south Kathiawar in Gujarat, also found in Maharashtra and adjacent

Rajasthan. Basic color of skin is white with dark red or chocolate-brown patches or sometimes black or purely red. Horns are peculiarly curved, giving a 'half moon' appearance. Milk yield is 1200 to 1800 kg per lactation. This breeds age at first calving is 45-54 months and the inter calving period is from 515 to 600 days. Gir cows are known for its hardiness and disease resistance.

Red Sindhi- This breed is also known as Red Karachi and Sindhi and Mahi. This breed was originated in Karachi and Hyderabad (Pakistan) regions of undivided India and also is reared in certain organized farms in our country. Its color is red with shades varying from dark red to light, strips of white. Its milk yield is 1250 to 1800 kg per lactation. Age at first calving is 39-50 months and inter calving period is from 425-540 days. Bullocks can be used for road and field work, though they are lethargic and slow.

Sahiwal – This has its origin in Montgomery region of undivided India. This breed is also known as Lola (loose skin), Lambi Bar, Montgomery, MultaniTeli. This is the best indigenous dairy breed. Its color is reddish dun or pale red, sometimes flashed with white patches. It is a heavy breed having symmetrical body with loose skin. Average milk yield is 1400-2500 kg per lactation. Age at first calving of this breed ranges from 37-48 months and the calving interval is 430-580 days.

Indigenous Draught Breeds of Cattle :

Hallikar - It originates from the former princely state of Vijaynagaram, presently part of Karnataka. Its color is grey or dark grey. This breed is compact, muscular and is of medium size. It has prominent forehead, long horns and strong legs. It is best known for its draught capacity and especially for its trotting ability.

Amritmahal- Its origin is in Hassan, Chikmagalur and chitradurga district of Karnataka. This breed was developed by the Maharaja of Mysore. This breeds are grey, but the shade may vary from white to near black. Its muzzle, feet and tail are usually black. They have long horns that end in sharp black points.

Khillari- Their origin is in Solapur and Sitapur districts of Maharashtra. They closely resemble the Hallikar breed. Its color is grey-white. But the new born have dusty red color that disappears in couple of months. It has long black horns sometimes pinkish running in a peculiar fashion. The bullocks of this breed are fast and powerful.

Kangayam- They are also known as Kongu and Konganad. They were originated in Kangayam, Dharmapuram, Perundurai, Erode, Bhavani and part of Gobichettipalayamtaluk of Erode and Coimbatore district. Coat is red at birth, but changes to grey at

about 6 months of age. Bulls of this breed are grey with dark color in hump, fore and hind quarters. The horns are spread apart. They are nearly straight with a slight curve backwards. Cows are grey or white in color. They are also observed in red, black, fawn and broken colors. Their eyes are dark and prominent with black rings around them. They are of moderate size having compact bodies.

Bargur- This breed is found around Bargur hills in Bhavanitaluk of erode district. It is developed for work in uneven hilly terrains. This cattle is brown in color with white markings. Some animals are white or dark brown in color. this breed of animals are well built, compact and medium in size. They are well known for their speed and endurance in trotting. They are very cautious in behavior and tend to stay away from strangers.

Umblachery- It is also called Jathimadu, Mottaimadu, Molaimadu, or Therkathimadu. This breed is originated in Tanjavur, Thiruvarur and Nagappattinam districts of Tamil Nadu. They are known for their strength and sturdiness and are suitable for wet ploughing. The calves of this breed are generally red or brown at birth with the characteristic white marking on face, limbs and tail. The legs have white markings below the hocks like socks. The bullocks of this breed are dehorned which is apeculiar practice in Umblachery cattle.

Pulikulam- It is commonly seen in cumbum valley of Madurai district in Tamil Nadu. It is also known by the names Jalikattumadu, Kidaimadu, Sentharai. It is small in size, usually grey or dark grey with farm markings. It has a well- developed hump. They are mainly used for penning in the field and ploughing. The characteristic feature of this breed is the presence of reddish or brownish spots in muzzle, eyes, switch and back. Their horns have backward curving of Mysore type cattle.

Indigenous Dual Purpose Breeds of Cattle :

Tharparkar- This breed was originated in Tharparkar district (Pakistan) of undivided India and also found in Rajasthan. It is also known by names White Sindhi, Gray Sindhi and Thari. They are of medium size, compact and their horns are lyre shaped. Their body color is white or light grey. The bullocks of this breed are suitable for ploughing and casting. The milk yield from the cows is 1800 to 2600 kg per lactation. First calving age ranges from 38 to 42 months and inter calving period is 430 to 460 days.

Hariana- The origin of this brees is in Rohtak, Hisar, Jind and Gurgaon districts of Haryana. They are also popular in Punjab, Uttar Pradesh and parts of Madhya Pradesh. The bullocks are powerful at work, but their horns are small. The cows are good milkers and yield about 600 to 800 kg of milk in lactation. Their age

at first calving is 40 to 60 months and inter calving period is 480 to 630 days.

Kankrej- It is otherwise called Wadad or Waged Wadhiar. Its origin is in southeast Rann of Kutch of Gujarat and adjoining Rajasthan (Barmer and Jodhpur district). They have lyre shaped horns. Their color varies from silver-grey to iron-grey or steel black. It is valued for fast, powerful, draught cattle. They are useful in ploughing and carting. The cows are good milkers and yield about 1400 kg per lactation.

Ongole- Also known as Nellore. Originated in Ongoletaluk in Guntur district of Andhra Pradesh. It is a large muscular breed having well developed hump. It is suitable for heavy draught work. Color is white or light grey. Average milk yield per lactation is 1000 kg. First calving age is 38 to 45 months, while the Inter-calving period is 470 days. This breed is exported to South East Asian and American countries for the development of meat cattle.

Krishna Valley- It is originated from black cotton soil of the water shed of the river Krishna in Karnataka and also is found in the border districts of Maharashtra. The animals of this breed are large. They have a massive frame with deep, loosely built short body. Their tail almost reaches the ground. It is commonly grey white in color with a darker shade on fore quarters and hind- quarters in male, while the adult females are more whitish in appearance. The bullocks are powerful animals useful for slow ploughing. They are valued for their good working qualities. The cows of this breed are fair milkers and the average yield per lactation is about 900 kg.

Deoni- It is also known as Dongerpati, Dongari, Wannera, Waghyd, Balankya, Shevera.Its origin is in western Andhra Pradesh. It is also found in Marathwada region of Maharashtra state and adjoining parts of Karnataka. Their body color is usually spotted black and white. Bullocks are suitable for heavy cultivation. First calving age ranges from 894 to 1540 days and inter calving averages 447 days.

9.5 EXOTIC DAIRY BREEDS OF CATTLE

Jersey- Its origin is in Jersey Island in U.K. it is the smallest animal of the dairy types of cattle. This breed has adjusted very well to the climate of India. So it is widely used in cross breeding with indigenous cows. Jersey cattle has typical color of reddish fawn. They have a compact and angular body with dished forehead. They are economical producers of milk with fat 4.5%. The age at first calving is 25 to 30 months and inter calving is 13 to 14 months. The average milk yield is 4500 kg per lactation.

Holstein Friesian- It was developed in the northern parts of Netherlands, especially in the province of Friesland. They possess large udder and they are ruggedly built. The mature cows weigh around 700 kg. they are the largest dairy breed. The typical marking of black and white makes them easily distinguishable. Average milk production of cow is 6000 to 7000 kg per lactation, but the fat content is low i.e. about 3.45%. Age at first calving is 29 to 30 months and inter calving is 13 to 14 months.

Brown Swiss- Brown Swiss breed has its origin in the mountainous region of Switzerland. In its origin place it is well known for good milk production and its rugged nature. The Karan Swiss is the excellentcross-bred cattle obtained by crossing this breed with Sahiwal cattle at NDRI, Karnal. The average milk production is 5000 kg per lactation with the fat content of 4%. First calving age is 28 to 30 months and calving interval is 13 to 14 months.

Red Dane- It is developed in Denmark. Its typical body color is red, reddish brown or even dark brown. It is a heavy breed wherein males weigh upto 950 kg and mature females weigh 600 kg. The lactation period of this cattle varies from 3000 kg to 4000 kg. The fat content is 4% and above. The age at first calving is 28 to 30 months and calving interval is 13 to 14 months.

Ayrshire - This is the most beautiful dairy breed and its origin is in Ayrshire in Scotland. They are very active animals, but it is hard to manage them. They do not produce milk and fat like other dairy breeds. They are also known as Dunlop cattle or Cunningham cattle.

Guernsey- They have their origin from small island of Guernsey in France. Its color varies from cherry red to brown. Mahogany and white is a variation in color. The milk of this breed may help to reduce the risk of certain cancers as it contains an exceptionally high content of beta carotene, which gives golden color to the milk. The milk yield from this cattle breed is 6000 kg per lactation. The fat content is 5% and the protein content is 3.7%. this breed is more advantageous than the other breeds due to its high efficiency of milk production, low incidence of calving, difficulty and longevity.

Dairy Breeds of cattle-

Jersey cross- Jersey cross breeds are produced by cross breeding the indigenous breeds of cow with jersey semen. They are suitable dairy animals for tropical plains of our country. They are well adapted to our climate and have better heat tolerance than other exotic crosses. They are of medium size. Jersey crosses may show 2-3 times increase in the milk yield in the first generation, depending on the milk production potential of our indigenous cows.

Holstein Friesian crosses-These crosses are more suitable for cooler climatic regions like the hilly areas as they are less tolerant to heat. They have less resistance to tropical diseases than jersey crosses. The milk yield is higher in Holstein Friesian crosses, but the fat percent is less.

9.6 BREEDS OF BUFFALOES

The buffalo species originated in India. The buffaloes are classified into river and swamp types. Both are called Bubalusbublis. Majority of the animals are river type. Swamp type are also found in certain parts of the country specially in eastern parts of India. India is considered as the home tract of some of the best buffalo breeds. Indian buffaloes are an important source of milk supply today and yield nearly three times as much milk as cows. Indian buffaloes are water buffaloes. There are about 10 indigenous standard breeds of buffaloes, well known for their milking qualities.

Murrah- It is the most important breed of buffaloes originated in Rohtak, Hisar and Jind of Haryana and Nabha and Patiala districts of Punjab. The color is usually jet black with white markings on tail and face and extremities sometimes found. An important character of this breed is tightly curved horn. It is massive having comparatively long neck and head, but the head of females is short, fine and clear cut, hips are broad and fore and hind quarters are drooping. The she buffaloes of this breed are one of the most efficient milk and butter fat producers in India. Average lactation yield vary from 1500-2500 kg. Age at first calving is 45-50 months and inter calving period is 450-500 days.

Nili Ravi- This breed is found in Sutlej valley in Ferozpur district of Punjab and in the Sahiwal district of Pakistan. The color is black with white marking on forehead, face, muzzle, legs and tall. The head is elongate, bulging at top anddepressed between eyes. The most desired character of the female is the possession of white markings. The horns are small and coiled tightly, and the neck is long, thin and fine. The frame is medium sized. The peculiarity of the breeds is the wall-eyes. The milk yield per lactation is 1500-1850 kg per lactation. Age at first calving is 45-50 months and the inter calving is 45-50 months.

Bhadawari- Its origin is in Agra and Etawah district of Uttar Pradesh and Gwalior district of Madhya Pradesh. Its body is wedge shaped and medium sized. The head is comparatively small and the legs are short and stout and the hooves are black. The hindquarters are uniform and higher than the forequarter. The peculiarity of this breed is the light copper colored body with eyelids

copper or light brown color. Two white lines ‘Chevron’ are seen at the lower side of the neck like that of Surti buffaloes. Its horns are black and curl slightly outward, downward before running backward parallel and close to neck, and finally turning upward. The ox are good draught animals with high heat tolerance. This breed is an efficient converter of coarse feed into butterfat. It is known for its high butterfat content. The fat content varies from 6 to 12.5 %. The average milk yield per kg is 800 to 1000 kg.

Jaffarabadi- The origin of this breed is Kutch and Jamnagar districts in Gujarat. This bred is found in its pure form in the Gir forests. They have massive head and neck as they are massive animals. Their forehead is very is very prominent, wide with a slight depression in the middle. Their horns are heavy that are inclined to droop at each side of the neck. The horns are curved but not curved tightly than in Murrah. They are usually black in color. these animals are owned and maintained by the nomads the Maldharis and they are traditional breeders. Average milkyield is 100 to 1200 kg. the ox are heavy and used for ploughing and carting.

Surti- It was originated in Kaira and Baroda district of Gujarat. Its skin is black or brown incolor and coat color varies from rusty brown to silver grey. The body is of medium sized and well shaped and the barrel is wedge shaped. Its head is long with prominent eyes. The horns are moderately long and flat and of sickle shape. Two white collars round the neck and brisket is the speciality of this breed. The age at first calving is 40-50 months and the inter-calving period is 400-500 days. Milk yield is 900 to 1300 kg and the high fat percentage in milk is 8-12 % which is the peculiarity of this breed.

Mehsana- This breed of buffalo is found in Mehsana town in Gujarat state and adjoining Maharashtra state. Color is mostly black; only a few have black –brown color. It is a cross breed of Surti and the Murrah breed. Body is longer and the limbs are lighter than in murrah. Their head is longer and heavier. Its horns are irregular in shape, but are less curved at the end but are longer compared to Murrah breed. It has good persistency. The milk yield ranges fro 1200 to 1500 kg and the inter calving period ranges from 450 to 550 days.

Nagpuri (Ellichpuri)- It was originated in Nagpur, Akola and Amravati districts in Maharashtra. It is a black colored animal with whit patches on face, legs and tail.. It is also known by names Ellichpuri or Barari. It has sword shaped horns long, flat and curved, bending backward on each side of the back almost to the shoulder. The advantage of this type of horns is that it helps to protect from wild animals and can move easily in the forest. The neck is little long and the face is long and thin. Average milk yield is

700 to 1200 kg per lactation and the age at first calving is 45 to 50 months and the inter calving period is 450-550 days.

Godavari- It is breed formed from cross breeding of the native buffaloes with the Murrah breed. Its origin is Godavari and Krishna deltaic area. They have a compact body and are of medium size. Its color is predominantly black with a sparse coat of coarse brown hair. Their peculiarity is that the average milk yield per day is 5-8litres per day with high fat content and the lactation yield is 1200 to 1500 litres. They breed regularly and have a short calving interval compared to Murrah breed.

Toda- It is the name given to the breed after the ancient tribe Toda of Nilgiris of south India. At birth the coat color of the calf is generally fawn, while in adults the coat color is fawn and ash-grey. This breed of buffalo is quite distinct from other breeds. They are indigenous to Nilgiri hills. The animals have a thick hair coat all over the body. The animals have long body, deep and broad chest, and short and strong legs. They have heavy head with horns set well apart. The horns curveinward, outward and forward. The animals are gregarious in nature.

Pandharpuri- It is native of Kolhapur, Solapurdistricts of Maharashtra. It is of medium size and have long narrow face. It has very prominent and straight nasal bone, comparatively narrow frontal bone and long compact body. Its body color varies from light black to deep black. The typical characteristic feature of this breed is that the horns are very long and curve backward, upward and usually twist outwards. The horns are so long that they extend beyond shoulder blade and sometimes up to pin bones.

9.7 CARE AND MANAGEMENT OF MILCH ANIMAL

The milch animals should be properly fed and necessary care and proper management practices should be followed, to get high milk production during any lactation.

The animals should be provided with green succulent forage together with leguminous hay or straw to the extent an animal can consume. By doing this the animals maintenance requirements are met with through forage only. Salt and mineral supplements should be given to maintain the lactation.

Always treat the animals in gentle manner and with kindness. Never frighten or excite the animals.

Maintain proper records of breeding and calving of the animals to ensure a steady flow of milk throughout the year.

Pay individual attention to feed each animal according to its production and maintain individual production records.

Keep up regularity in feeding.

Provide water to drink at will or at frequent intervals.

Regularity should be there in milking. Milking thrice is better than twice.

Rapid, continuous dry hand milking should be practiced without undue jerking of teats. Milking should be done with whole hand.

Cows should be trained to let down milk without calf suckling.

Shelter should be provided during the hot part of the day in the form of loose housing system so that they can get maximum exercise.

Grooming of the cows and washing of the buffaloes before milking help in clean milk production and also will keep the animal hide pliable.

Wallowing of the buffaloes or water spraying on their bodies will keep the buffaloes comfortable especially in summer.

Common ailments should be properly detected and treated.

Common vices like kicking, licking, suckling, etc should be properly detected and taken care of.

Provide sufficient dry period between calving at least 60-90 days. If it is not sufficient the milk yield in subsequent lactation will be reduced.

Check for mastitis regularly. Vaccination against important diseases is must. Also guard the animals from insects and pests.

Number the cows and record the particulars pertaining to milk, fat %, feed taken, breeding, calving and drying dates.

Factors Affecting Breeding Efficiency :

Factors affecting breeding efficiency of cattle are as follows:

1) Number of ova- The first limitation on the breeding efficiency of fertility of an animal is the number of functional ova released during each cycle of ovulation. The time of mating in relation to ovulation is important for effective fertilization.

2) Percentage of Fertilization- The second limitation is fertilization of ova.

3) Embryonic Death- From the time of fertilization till birth, embryonic mortality may occur due to a variety of reasons. Hormone deficiency, accidents in development, over-crowding in the uterus, insufficient nutrition or infections in the uterus or

hormonal imbalance may causes failure of Implantation of fertilized ova which die subsequently.

4) Age of first pregnancy- Breeding efficiency can be lowered by increasing the age of first breeding. The mature size of the female is affected little if they are bred at a lower age.

5) Frequency of Pregnancy- The breeding efficiency of the females can be enhanced, by lowering the interval between successive pregnancies. Lifetime efficiency is increased if the female is bred at an early age for the first time and rebred at almost the earliest opportunity after each pregnancy.

6) Longevity- The length of parent life is an important part of breeding efficiency. The longer the life of parents, smaller is the percentage of milch animals needed for replacement every year.

Housing :

Good housing play an important role for keeping the animal healthy, productive and disease free. Required space inside the house is necessary for the proper production. Ensure availability of all types of essential facilities like proper ventilation, sufficient flow of fresh and clean air, sufficient space in the house.

Feeding :

Always feed the animals with sufficient amount of nutritious food, as feeding good and high quality nutritious food ensures proper growth and good health of the animals. Give green food in large quantity as it helps the animal to produce more milk. Along with nutritious food always provide clean and fresh water.

Care & Management :

The key to every livestock farming business is taking good care of the animals. Try to keep them free from all types of cattle diseases. Timely vaccination is necessary. Regularly provide the animals with nutritious food and clean water. Keep stock of necessary medicines and other useful materials handy.

Marketing :

In India there is a great demand for dairy products and therefore marketing the dairy products is not a problem. Dairy products can be sold at almost at every place in the country.

9.8 SUMMARY

To produce the targeted quantity of green fodder the best option is to maximize the fodder production per unit area and per unit time. High yielding fodder crops and fodder crop sequences

are important to harness year round fodder production. At this juncture intellectual stimulation and economic rewards are essential to attract and to retain youth in dairy farming for sustainable development. This could be achieved only by generation of meaningful and viable technologies and transferring the same for adoption by the millions of rural folk.

9.9 QUESTIONS FOR SELF-STUDY :

1) Give the benefits, advantages and problems of dairy farming in India.
2) Answer in brief- The different breeds of cows.
3) Answer in brief- The different breeds of buffaloes.
4) Write in detail about the caring and management of milch animals.
5) What are the factors affecting the breeding efficiency of dairy animals?
6) Write short notes:
   a) Selection of dairy breeds
   b) Exotic breeds of cows

10

DAIRY INDUSTRY

Unit Structure :

10.0 OBJECTIVES

1) To study the scope of dairy industry in India
2) To study the problems related with this sector
3) To study the efforts made by Indian government to increase milk production
4) Effect of Globalization and Liberalization on dairy industry in India

10.1 INTRODUCTION

Dairy industry in India traditionally has been an integral part of the country's economy. In India dairying is regarded as an instrument for social and economic development. The country's milk supply comes from millions of small producers, who are dispersed throughout the Indian rural areas. All these farmers maintain an average herd of one or two milch animals, comprising of cows and /or buffaloes. The farmers are encouraged to practice dairying as an subsidiary occupation to agriculture due to ample labor and less land space. Income from agriculture is seasonal, but dairying provides a stable income all the year round and is like an important economic incentive for the small farmer. The crossbred technology in the Indian Dairy Industry has augmented the viability of the dairy units by increasing the milk production per animal.

Subsequently milk production also increased at an exponential rate while the benefits of an increase in milk production also reached the consumers from a relatively lower increase in the price of milk.

India is the world's largest producer and consumer of dairy products. Almost the entire produce is consumed in the domestic market. Though India has the world's largest cattle population, the average output of an Indian cow is significantly low. The other problems related with this sector are the shortage of fodder, its poor quality, inadequate transport facilities and poorly developed infrastructure, resulting in lack of elasticity on the supply side that is expected.

The situation is buoyant on the demand side. The sustained growth of the Indian economy and the consequent rise in the purchasing power, more and more people can afford to buy milk and other dairy products.

The Indian government and other stake-holders efforts led to an increase in milk production. The factors responsible for this are newfound interest on the part of the organized sector, new markets, easy credit facilities, dairy friendly policies by the government, etc. Dairy farming has now evolved from just an agrarian way of life to a professionally managed industry- The Indian Dairy Industry. This is an indication of another white revolution in the country.

Now India is the highest milk producer in the entire globe. India is known as the 'Oyster' of the global dairy industry, giving lots of opportunities to the entrepreneurs globally. The Indian dairy industry has achieved this strength of a producer owned and professionally managed co-operative system, despite the facts that a majority of dairy farmers are illiterate and run small, marginal operations and for many farmers, selling milk is their sole source of income.

To capitalize on the largest and fastest growing milk and milk products market can be a dream of any nation in the world. Liberalization has led to a rapid growth of the Indian dairy industry, providing good opportunities for multinational companies and foreign investors to release the full potential of this industry. To manage the national resources to enhance milk production and upgrade milk processing using innovative technologies is the main objective of the Indian dairy industry.

10.2 SCOPE OF DAIRY INDUSTRY IN INDIA

Globalization and Liberalization are the main factors of the new economy in India and is now on the fast track today. Industrial

production is increasing at a great speed and dairy industry is no exception to that. There is no doubt there is tremendous scope for the growth of the dairy industry as the imports and exports are getting liberalized in the global economy, with the World Trade Organization coming into effect from 1st April 2001. As the standard of living in the importing countries rise, exporting countries will increasingly concentrate on whole milk powder and cheese with the assistance of butter and skimmed milk powder. As the cost of milk production in India is lowest, there is vast potential for the export of dairy products. The major factor influencing production of bye products is the newer use that may be developed through Research and Development support. Milk proteins are being utilized increasingly replacing animal and vegetable proteins in special bakery products and instant foods. Through the application of membrane proven process, milk proteins isolates are produced and are utilized for ice milk mixes and such other applications. There is tremendous scope for the broadening of the product range and some of the products. There are more than thousand varieties of cheese, out of which Cheddar, Mozzarella, Gouda and Processed cheese are manufactured in India. Varieties of milk shakes are also increasing wherein milk and fruit pulp are mixed in different proportions to produce different beverages. Some of the beverages can also be produced in dehydrated form and can be excellent health food. Many of the organized dairies are involved in the manufacture of varieties of traditional milk based sweets like pedha, paneer, shrikhand, etc which can go national. As the world is getting integrated into one market, quality certification is becoming essential. International Organization for Standardization (ISO) and Hazards Analysis and Critical Control Point (HACCP) certification also is essential in the market. There is great scope for introducing newer plants adopting new processes by the dairy industry in India. Another promising area in dairy industry is the packaging of dairy products. Non Residential Indians and Overseas investments can take place in manufacturing dairy processing equipment, fruit packaging equipment and equipments for biotechnology related to dairy industry.

10.3 OPERATION FLOOD

The National Dairy Development Board (NDDB) launched Operation Flood Program under the chairmanship of Dr. Kurien for the transition of Indian milk industry from a situation of net import to that of surplus production of milk in the country. Operation Flood Program was launched in 1970. It has led to the modernization of India's dairy sector and also created a strong network for procurement processing and distribution of milk by the co-operative sector. The main trust of this program was to organize dairy co-operatives in the milk-shed areas of the village, and link them to the

four Metro cities, the main markets for milk. The efforts taken by NDDB have not only led to increased production, but also have led to the emergence of dairying as an important source of employment and income generation in the rural areas. The operation flood program also has led to an improvement in yields, longer lactation periods, shorter calving intervals, etc. by using modern techniques.

Establishment of milk collection centers and chilling centers has enabled minimization of wastage due to spoilage of milk. It also has enhanced the life of raw milk. Operation Flood has been one of the world's largest dairy development programs. A few other countries have also adopted the model of India's White Revolution, after the success achieved in India by adopting the co-operative route.

Operation flood the successful Indian dairy development program analyzed how food aid can be utilized as an investment in building an institutional infrastructure and can bring about national dairy development.

Total contribution to the economy-

The Indian Dairy Industry is involved in the manufacture of various dairy products like cheese, curd, yoghurt etc. It is also engaged in the production and processing of milk and cream. The Indian Dairy Industry (IDA) specializes in the procurement, production, processing, storage and distribution of dairy products. In the international scenario India as a nation stands first in its share of dairy production.

Employment opportunities-

The Indian Dairy Industry provides gainful employment to a vast majority of the rural household especially the women folk. Job opportunities are mainly in the fields of production and processing of dairy products. An individual having bachelor degree course in dairy technology can easily avail the opportunity to work in this industry. One has to qualify the All India Entrance Test affiliated to the Indian Council Of Agricultural Research for the graduation course in dairy technology. Later on he can persue for Master's degree. Following job opportunities are available –

Dairy Scientists- A dairy scientist has to deal with the collection of milk and take care of high yielding variety animals.

Dairy Technologists- The dairy technologist is the procurement officer who takes the responsibility of collecting milk from farmers, milk booths and cattle rearers. He should well understand the latest technology that is applicable in maintaining the quality of milk in the process of transporting it to the desired location.

Dairy Engineers- They are appointed to set up and maintain dairy plants.

Marketing Personnel- They deal with the sale and marketing of milk together with milk products.

Intensive Dairy Development Program (IDDP) – The schemes modified under this program were on the basis of the recommendation of the evaluation studies launched during eight-plan period and are still being continued.

Strengthening Infrastructure for Quality and Clean Milk Production (CMP) – This scheme was launched in October 2003, a centrally sponsored scheme having the main objective of improving the quality of raw milk produced at every village level in India.

Dairy Venture Capital Fund- This was introduced in the Tenth Five Year Plan to bring structural changes in the unorganized sector that would measure milk processing at the village level, marketing of pasteurized milk in a cost effective manner, quality or up gradation of traditional technology to handle commercial scale using modern equipment's and management skills.

The country's 12^{th} plan aims at taking the current milk output from 115-116million tons to 150 million tons or so by the year 2017. The plan lays more emphasis on increasing the productivity, so that the costs milk and milk products can be kept down.

10.4 OPPORTUNITIES AND CHALLENGES IN THE INDIAN DAIRY INDUSTRY

Dairy industry is of crucial importance to India as it is the worlds largest producer of milk, accounting for more than 13% of worlds total milk production. It is the worlds largest consumer of dairy products, consuming almost 100% of its own milk production. Dairy products are a major source of cheap and nutritious food to millions of people in India. It is the only acceptable source of animal protein for large Indian vegetarian population, particularly among the landless, small and marginal farmers, children and women. Dairying is considered as one of the activities aimed at alleviating the poverty and unemployment especially in the rural areas in the rain-fed and drought prone regions.

Main areas of concern in the Dairy Industry

1) Competitiveness, cost of production, productivity of animals- As in developing countries, demand for quality dairy products is rising it is therefore necessary to increase competitiveness of Indian dairy industry. Efforts should be made to reduce cost of

production. The factors that can reduce the cost of milk production are increasing productivity of animals, better health care and breeding facilities and management of dairy animals. Indian government and dairy industry can play a vital role in this direction.

2) Production, processing and marketing infrastructure- It is essential that we should develop proper production, processing and marketing infrastructure, capable of meeting international quality requirements, if India has to emerge as an exporting country. A comprehensive strategy has to be formulated with suitable legal backup for producing quality and safe dairy products.

3) More attention on buffalo milk based special products- As the availability of buffalo milk is in large proportion, India can focus on buffalo milk based special product, like Mozzarella cheese, to meet the needs of the target consumers.

4) Import of value added products and export of lower value products- The liberalization policy has made it possible for Indian companies to import more value added products and export lower value products. The dairy industry has to prepare itself to meet the challenges in the future.

5) Provision of SPS and TBT at international level- It is to be ensured that provision of Sanitary and Phytosanitary Measures Agreement (SPS) and Technical Barriers to Trade (TBT) Agreement are based on application of sound specific principles.

10.5 INDIAN DAIRY ASSOCIATION (IDA)

IDA is the apex body of the dairy industry in India and was established in 1948. The members of this apex body are from co-operatives, MNC's, corporate bodies, private institutions, educational institutions, government and public sector units. It functions closely with the dairy producers, professionals and planners, scientist and educationist, institutions and organizations associated with the development of dairying in India. IDA has been providing a common forum to knit together the dairy fraternity. An apex policy body called the Central Executive Committee (CEC), headed by the President, supported by two Vice-Presidents and 19 Executive Committee Members, manages the association. IDA has emerged as a platform for assimilation and dissemination of knowledge, as an important tool for policy making in the dairy sector in India. IDA organizes seminars, symposia and exhibitions on wide range of topics catering to various segments of

professionals, scientists, institutions and organizations associated with the development of dairying in India. IDA provides technical and scientific information to all the members both to individual as well as institutions. Indian Journal of dairy science a publication of IDA is a bimonthly journal, which primarily covers research articles, mainly to organize periodic conferences, seminars and workshops on subjects of current interest to maintain an inventory of the dairy scientists, research workers and dairy planners and professionals employed in the different sphere of the dairy industry including consultants in the field. IDA being a representative body of the Indian dairy sector intervene from time-to-time on the policy issues like pre-budget memorandum, addressing issues arising out of tariff rates, import / export, sanitary standards etc. IDA addresses the issues arising out of WTO / SPS etc. it has a fairly well equipped library and maintains Data Bank, which stores information on Indian Dairy Industry as well as international Dairy Industry.

The objective of IDA :

1) It involves the advancement of dairy science and industry, farming, animal husbandry, animal sciences and its branches including dairy farming and research on breeding and management of dairy livestock.
2) To promote and participate in every way the rational and economic development of dairy science, industry and farming in the country in association with co-operatives, industry, or any other organization, national or international, having similar aims and objectives.
3) To collaborate with most of the societies, associations or any other organizations, national or international, having similar aims and to participate in meetings held in India or abroad.
4) To assume functions when asked to do so, on behalf of Government towards the advancement of dairying.
5) To adopt an appropriate logo for the association and to permit the use thereof by its members on such terms as may seem appropriate.
6) To promote good standards and to foster the growth of the dairy industry in general and for the purpose engage in consultancy activities.
7) To set up laboratories and do such like or other things are necessary for the purpose.
8) To promote dairying,for the benefit of livestock and agricultural farmers as a part of animal husbandry activity in particular and agricultural farming in general.

9) To organize training, exhibitions mostly help in establishment of dairy farm as a part of animal husbandry activity for the benefit of agricultural, livestock and dairy farmers.

10.5 EXPORT POTENTIAL

Indian Traditional Milk Products :

There are a large variety of traditional Indian milk products like-

Dahi, Lassi, Makkhan, Ghee, kheer, Basundi, Rabdi, Paneer, khoya. The market for these indigenous based milk food products is difficult to estimate as most of these products are manufactured at home or in small cottage industries catering to the local areas. Consumers purchasing dairy products look for freshness, quality, taste and texture, variety and convenience. The products like dahi, and sweets like kheer, basundi, rabdi are manufactured and sold by local milk and sweet shops as they are perishable items and have a shelf life of less than a day. Consumers loyalty is built by keeping consistency in the quality, taste and freshness. Several sweet shops have built a strong brand franchise and have several branches located in various parts of a city, state or country.

India has the potential to become one of the leading countries in milk and milk product exports. As India is located amidst major milk deficit countries in Asia and Africa, as a result major importers of milk and milk products are Bangladesh, China, Hong kong, Singapore, Thailand, Malaysia, Philippines,

Japan, UAE, Oman and other gulf countries are all located close to India.

As the milk production is scale insensitive and labor-intensive cost of labor is low. And so the cost of production of milk is significantly lower in India.

There is a vast market for the export of traditional milk and milk products such as ghee, paneer, shrikhand, rasgullas, and other ethnic sweets for the large number of Indians scattered all over the world. So the major concerns in export competitiveness are Quality and Productivity of milk and milk products.

Quality- Training should be provided to improve the quality to bring it up to international standards, which needs significant investment in milk procurement, equipment's, chilling and refrigeration facilities.

Productivity- It is imperative to improve productivity of Indian cattle to have an exportable surplus in the long-term and also to maintain cost competitiveness.

10.6 FACTOR CONDITION FOR DAIRYING

Factor conditions for dairying entail the quality of animals, human resources and technical skills, land availability, capital, credit, infrastructure and other inputs relevant to the value chain.

The quality of animals is essential in determining its milk productivity and hence overall production. Low productivity per animal hinders the development of the dairy sector. The low productivity is a result of ineffective cattle and buffalo breeding programs, limited extension and management on dairy enterprise development, traditional method of feeding not based on scientific feeding methods, limited availability and affordability of quality feed and fodder. The limited supply of quality animals is exacerbated by policies limiting interstate movement of animals.

Animal health and breeding services provision, veterinary infrastructure development and vaccinations are the responsibility of the state government. These services have been provided free or at a subsidized rate.

Herd – A very large number of indigenous animals with low productivity and a small portion of cross breed animals are reared.

Breed- Strengthening of indigenous breed is not there due to lack of policy focus. Poor awareness of quality feed hinders productivity.

Feed-The farmers are not interested in quality feed due to the low price of milk and increasing feed costs.

Veterinary medicine- Availability of veterinary medicine is not an issue but duplicate or cheap medicine is an issue.

Human Capacity- a) Farmer technical capacity, knowledge and new techniques are not accessible. Major issue in many parts of the country is the support services, technical capacity and accessibility to good quality veterinary services. **b)** Organization and Managerial capacity- Organizational and managerial capacity of farmers co-operatives is very poor**. c)** Entrepreneurial Capacity- Entrepreneurial capacity is hindered by a low capacity to risks in credit or finance market. **i)** Formal Credit Mechanisms- Access to formal credit mechanism is very poor. **ii)** Informal Credit Mechanism- Easily accessible but at a very high interest rate.

External economies-Transmission of learning- Very poor extension support services, lead to a poor knowledge transfer.

Social Capital and Trust- Properly managed strong social capital and trust in the villages can sustain dairy farmer organizations if properly managed.

The milk co-operatives and NGO's provide services in many states in addition to the state department of animal husbandry. Also the trained private sector artificial insemination AI technicians provide services with a nominal fee. Along with this state livestock development agencies are set up as autonomous bodies to offer services in animal breeding in the form of procurement, production and distribution of breeding inputs (semen and liquid nitrogen), training and promotional activities.

Even though so many efforts are taken, the availability of services remains limited. Due to lack of co-ordination the cattle and buffalo breeding programs did not have the desired impact. Also, extension activities in dairy management are lacking. As the farmers lack information of feeding and management practices they are not able to take advantage of the potential of their animals. Giving proper knowledge to women folk involved in livestock rearing would enhance dairy production considerably.

Crop residues like coarse straws, fine straws, leguminous straws, pulses straws and sugarcane tops are the single largest bulk feed material available to farmers for feeding livestock, especially the ruminants. A major constraint in availability of the fodder resources is lack of efficient management of common property resources.

Concentrates used for fodder include coarse grains like maize, sorghum, bajra and other millets, cereal products like rice bran/polish and various oil meals, including groundnut cake, mustard cake, coconut cake, soybean meal, cotton seed meal and sesame cake. The rising price of feed is a major concern, so in many places co-operatives are involved in producing feed concentrate and selling at subsidized rates to the farmers. Unless adequate measures are undertaken to augment the scarcity of fodder resources, it would be a major constraint in the development of the dairy sector.

Lack of regulations to ensure quality is also an important issue regarding the feed of livestock and as a result all kinds of substandard feeds are available in the market.

Formal / informal credit- As the access to credit is very less expanding the herd of livestock is extremely difficult. There is little

access to formal credit through the co-operatives. Private traders and agents of private companies provide informal credit but at a higher interest rate. Taking loan from a trader binds the farmer to sell the milk to that trader only often at a very low price.

Vaccines / Medicines- Government and private sectors are involved in the production of medicines and vaccines, but quality control is a critical issue. There is a doubt or an important policy question whether the government should manufacture medicines and vaccines or it should take a regulatory role to ensure quality and availability at a reasonable price.

Related Supporting Industries- Strong and supporting industries are essential for the development of any industries. In case of dairy industry, the National Dairy Research Institute pursues research and education in all the aspects of dairying- microbiology, chemistry, technology, engineering, animal genetics and breeding, livestock production and management, animal nutrition, animal physiology, dairy economics and dairy extension education.

Processing capacity- Lack of processing capacity in the country, including processing by bulk chilling.

Processing capacity- Government gives subsidies on bulk chilling and processing infrastructure.

Transportation and distribution- Transportation costs for procurement are high due to low productivity.

Dairy farmer services- Health and breeding services can be enhanced. Extension is almost non-existent.

Specialized finance and credit- It exists only on paper, but is difficult to access. There is significant private sector investment in feed manufacturing and the manufacturing of medicines and vaccines.

Processing capacity-There is immense scope to increase the processing capacity and direct a major share of milk and milk products through the formal channel.

10.7 BRANDING OF TRADITIONAL MILK PRODUCTS

Ghee is the only traditional milk product, which is currently marketed in branded form. The main ghee brands are Sagar, Milkman (Britannia), Amul (GCCMMF), Vijaya (AP Dairy Development Co-operative Federation), Verka (Punjab Dairy Cooperative), Everyday (Nestle) and Farm Fresh (Wockhardt).

Increasing urbanization and changing consumer preferences has led to the possibility of large-scale manufacture of indigenous milk products also. There is versatility in the equipment's in milk manufacturing that can be adapted for several products. For example, equipment's used to manufacture yoghurt can also be adapted for large scale production of Indian curd products like dahi and lassi. Under the aegis NDDB significant research work on dairy equipment's has been done.

Mafco Limited sells Lassi under the Aarey brand and flavoured milk under the Energee franchise (in the western region, mainly in Mumbai). Britannia has launched flavored milk in various flavors in tetra packs.

GCMMF has also launched packed paneer under the Amul brand. It has alos created a new umbrella brand " Amul Mithaee" for a range of ethnic Indian sweets in major Indian markets.

Western milk products such as butter, cheese, yoghurt have become popular in the Indian market only a few years back. With increasing urbanization consumption also has been increasing. The major brands producing these products are Amul, Vijaya, Sagar, Nandini, Aarey, Britannia, Dabon, Verka, Vadilal. But Amul has become more aggressive with the launch of new variants such as Mozzarella cheese, cheese powder, etc.

Milk powder / Dairy whiteners- Major skimmed milk brands are Sagar (GCMMF) and Nandini (Karnataka Milk Federation), Amul Full Cream milk powder is a whole milk powder brand. Leading brands in dairy whitener are Nestle's Ebvery day, GCMMF 's Amulya, Dalmia industry's Sapan, Kwality Dairy India's Kream Kounty, wockhardt's Farm Fresh and Britannia's Milkman Dairy Whitener.

Nestle's Milkmaid is the leading brand in the condensed milk market. The only other competitor is GCMMF's Amul.

Nestle (Cerelac and Nestum) is the market leader in the infants food segment. On the second position is Heinz (Farex). This is a category where brand loyalties are very strong, as mothers want the best for their babies. Wockhardt is a new entrant in this field proposing to launch new baby food Easum containing moong an easily digestible pulses.

10.8 SUMMARY

India is the highest milk producer in the entire globe. India is known as the 'Oyster' of the global dairy industry, giving lots of

opportunities to the entrepreneurs globally. The Indian dairy industry has achieved this strength of a producer owned and professionally managed co-operative system, despite the facts that a majority of dairy farmers are illiterate and run small, marginal operations and for many farmers, selling milk is their sole source of income.

To capitalize on the largest and fastest growing milk and milk products market can be a dream of any nation in the world. Liberalization has led to a rapid growth of the Indian dairy industry, providing good opportunities for multinational companies and foreign investors to release the full potential of this industry. To manage the national resources to enhance milk production and upgrade milk processing using innovative technologies is the main objective of the Indian dairy industry. Globalization and Liberalization are the main factors of the new economy in India and is now on the fast track today. Industrial production is increasing at a great speed and dairy industry is no exception to that.

10.9 QUESTIONS FOR SELF-STUDY

1) What is the scope for dairy industry in India?
2) Write in detail ‘The Operation Flood’.
3) What are the opportunities and challenges in the Indian dairy industry?
4) What is the role and objective of Indian Dairy Association- IDA?
5) What are the factor conditions for dairying?
6) Write short notes on:
    a) Export potential of dairy industry
    b) Branding of traditional milk products
    c) Impact of globalization and liberalization on Indian dairy industry

11

GOAT FARMING

Unit Structure :

11.0 OBJECTIVES

1) To study the role of goat rearing in India
2) To study the different breeds of goat
3) To know the advantages of goat farming
4) To study goat rearing and integrated farming system
5) To study the management and breeding of goats

11.1 INTRODUCTION

Goat rearing plays a significant role in the rural economy of the country specially, in the mountainous, semi-arid and arid regions of India. As goat is a multifunctional animal it plays an important role in the economy and nutrition of rural landless, small and marginal farmers. Goat rearing is practiced on large scale in rural India. Goats are kept as a source of additional income and as an insurance against disasters and calamities. Goats can survive on available shrubs and trees. In India goats are used during the ceremonial feastings and they also have religious and ritualistic importance in many societies. Increasing demand of goat meat and milk in India is a hope for widely spreading this industry. In India goats are among the main meat-producing animals and also, goat

meat is preferred to other meats. Goats are also suitable for milk, fiber and skin production. High quality manure also is obtained from the goats that help to increase the production of crops. So commercial goat farming is becoming very popular in India.

11.2 ADVANTAGES OF GOAT REARING

Goats are friendly animals and enjoy being with the people. Goats are multipurpose animals producing milk, meat, fibre and skin together. The initial investment in goat farming is very low as the goats housing and management costs is low due to its small body size and docile nature. In short goat farming requires less space and additional facilities. in small goat farming they share their homes with owners other live-stocks. In drought prone areas risk of goat farming is very less compared to other livestock species. Goats are prolific breeders. They achieve sexual maturity at the age of 10-12 months and it starts giving milk at the age of 16-17 months. Twinning is very common. Both male and female goats have equal value. The goats can thrive well on thorny bushes, weeds, crop residues, agricultural by-products not suitable for humans. So we can say they are ideal for mixed species grazing. Goats can improve and maintain grazing lands and also reduce bush encroachment without harming the environment. Without causing any environmental issues slaughtering and dressing operation and meat disposal can be carried out. Goat milk is easy to digest than cow milk because of small fat globules and is naturally homogenized and improves appetite and digestive efficiency. Goat milk is non allergic and has anti-fungal and anti-bacterial properties. So it can be used to treat urogenital diseases of fungal origin. Goat is also called as a walking refrigerator for the storage of milk. It can be milked a number of times in a day. Goat rearing creates employment to the rural poor people. Ample scope is there to establish cottage industries based on goat meat and milk products, skin and fibre.

11.3 DIFFERENT BREEDS OF INDIAN GOATS

Around 19 well-defined Indian breeds of goats are scattered throughout the country. Other than this there are a number of local non-descript goats found in India. The well-defined goats are classified based on their locations.

They are -

a) Himalayan Region b) Northern Region c) Eastern Region d) Southern Region e) Central Region

a) Himalayan Region (Hilly Area)

States of Jammu and Kashmir, Himachal Pradesh and parts of Uttar Pradesh come under this region.

1) Pashmina- This breed is small dainty animal with quick movements. They are raised in the Himalayas, Lahaul, Ladakh and Spiti valleys. Softest and warmest fibre is produced by this breed, which is used for high quality fabrics.

2) Chegu- This breed yield pashmina, good meat and less quantity of milk. They are found in the mountainous ranges of Spiti, Yaksar and Kashmir.

3) Himalayan Breed- This breed is found in Kangra and kullu valleys, Sirmur, Chamba and Simla in Himachal Pradesh and parts of Jammu hills. Their local names are gaddi, jamba, Kashmiri as per the areas where they are reared. The goat of this breed is white haired and sturdily built.

b) Northern Region

States of Punjab, Haryana and parts of Uttar Pradesh come under this region. Important milch breeds of goats come from this region.

1) Beetal- This breed is evolved from Jamunapari breed and mainly found in Punjab. The color of this breed is red and tan, heavily spotted on white. Does give milk about I kg milk daily and bucks may have a beard.

2) Barbari- It is found in Etawah, Etah, Agra and Mathura districts of Uttar Pradesh, Kamal, Paniphat and Rohtak in Haryana. The breed is small and short haired, with erect horns and varies in white,red and tan spots. They are stall fed and yield 0.90 to 1.25kg of milk daily. They are highly fit for intensive rearing. They usually kid twice in 12-15 months.

3) Jamunapari- This breed is the native of Etawah district of Uttar Pradesh. They are large sized, tall, leggy having large folded pendulous ears and a prominent Roman Nose. They carry long and thick hair on their hind quarters and have glossy coat. They have short flat horns. The daily milk yield is 2.25 to 2.7kg. The Anglo-Nubian breed of goat in England are evolved from Jamunapari goats.

C) Eastern Region

This region covers the areas of West Bengal, Assam, Tripura, Orissa and some part of Bihar.

1) Assam Hilly Breed- this breeds are smaller dwarf breeds of goat and are found in the hilly tract of Assam and other Eastern states.

2) Bengal- This breed is small short and found in three colors black, brown and white. Their meat is of superior quality. The skin of this breed is of excellent quality and there is a great demand for it in India and abroad in footwear industry. Does kid twice in a year.

D) Southern Region

States of Maharashtra, Gujarat, Andhra Pradesh, Tamil Nadu and Kerala come under this region.

1) Osmanabadi or Deccania-They are a mixture of goats of the plains. Their color is black, mixtures of white and black or red. They yield 1.4 to 2.25 kg daily.

2) Malabar or Tellicherry- This breed is found in Northern Kerala.

3) Surti-They resemble Berari goats having white, short legs and are popular in Mumbai, Nasik and Surat. The milk yield per day is 2.25 kg.

4) GBRI-They are a mixture of two or more types of goats. They may vary from black to white and their color is not uniform. They yield 0.9 to 2.8 kg of milk daily.

E) Central Region

The areas included in this region are Rajasthan, northern parts of Maharashtra, Madhya Pradesh and Gujarat.

1) Marwari, Mehsana and Zalwadi- These breed is derived from Jamunapari breed and is found in different color combinations. It is commonly found in Gujarat, Rajasthan and Madhya Pradesh. The milk yield per day is 0.75 to 1kg.

2) Kathiawari- it is a native of Northern Gujarat, Rajasthan and Kutch. This breed have black coat with reddish color marks on the neck. They yield 1.25 kg of milk per day.

3) Berari- This breed is found in Nagpur and Wardha districts of Maharashtra and Ninar district of Madhya Pradesh. They are tall dark colored goats. The daily milk yield of this breed is 0.6 kg.

11.4 EXOTIC BREEDS OF GOATS

The exotic breeds are noted for their higher milk breeds. They were imported to India to improve milk yield of the local breeds.
They are as follows-

1) Sannen- This goat is a native of Sannen valley in Switzerland. It is famous for its consistency and high production. Their color is white or light cream. The ears point upward and forward and face is slightly dished. The average milk yield is 2 to 5 kg per day.

2) Toggenberg- Its origin is in Toggenberg valley in north Switzerland. Its skin is very soft and pliable and the male goat has usually long hair than females. Both male and female goats are hornless. Average milk production per day is 5.5 kg.

3) Angora- Its origin is in Turkey or Asia. It is small in size with short legs.its horns are grey and spirally twisted and are inclined backward and outward. Their tail is short and erect. The soft silky hair covers the white body. This breed produces mohair, which is a superior quality fibre. The fleece drops off naturally as the summer approaches if it is not shorn during spring season. The average fleece yield is 1.2 kg, while in good animals it is even up to 6 kg.

4) Alpine- Its origin is in Alp Mountains. It is a cross breed of French, Swiss and Rock Alpine breeds. No distinct color had been established. They are excellent milk givers and have horns. The milk yield is 2 to 3 kg daily.

5) Nubian- Nubia in North Eastern Africa is the origin place of this breed. It is also found in Ethiopia and Egypt.It has long legs and is a hardy animal.

6) Anglo Nubian- This Anglo Nubian breed was derived by cross breeding Nubian, Jamunapari breed of India with native breeds of U.K. It is a big animal with a fine skin and glossy coat. It has pendulous ears and Roman nose. This breed is known as the jersey cow in the goat world. They have no fix color. Average milk yield is 3 to 4 kg per day and also can increase up to 6.5 kg or more.

11.5 GOAT REARING AND INTEGRATED FARMING SYSTEM

Goat housing is an important aspect of goat rearing. The basic necessities of goat housing are location with low, as well as hilly areas, good irrigation, quality air, tree shades etc. Goat houses must have good height so that goats can stand tall. The goat house

should be well ventilated, should have sufficient space for feeding, there should be proper drainage system in the house. An individual goat should be provided a space of at least $4m^2$. Supply of fresh water, milking space, dry space for keeping feeds, good and dry flooring with proper bedding is also required. The houses should protect the goats against wild animals and bad weather conditions. Proper management schedule should be maintained for all the activities in the farm. Effective cleaning mechanism is much necessary as chances of infection are more. Sufficient staff should be there to carry out the activities like feeding, cleaning, hair trimming, dehorning, hoof trimming, separation etc.

Free grazing system is suitable for large farms, but management of wandering goats is a big task. Goats allowed to graze freely during day time at controllable space will be good as it helps the goats to graze good herbs as well as grass.

Stall Fed Farming-

This is an intensive integrated farming systems where in the stall fed goats fit in. The milky-type animals are ideal for integrated farming system. Many farmers have successfully run stall fed goat farms and found it was more productive and profitable. Goats are the most efficient converters of farm and crop residues into excellent organic manure.

Goats relish the stalks and residues of most of the nutritious cereals when mixed with green fodder (grasses and subhabul). Special goat feeds can be formulated by using millets and oilcakes. The actual cost of raising the goats is minimized as the cost of feed and labor gets distributed over the farming operations. The goat manure is ideal to be used as a fertilizer in the fishponds and all other crops, is also a good material as a base for vermicomposting. The space required per adult animal is about one square meter. Stall fed goat farming is said to be an ideal occupation for the small and marginal farmers and also landless agricultural laborers.

To keep a small herd of goats small shed having good cross ventilation is sufficient. A deep litter system with bedding material of paddy husk and groundnut shell is ideal for raising goats. The bedding material should be changed after six months. The bedding should be turned periodically to remove the fowl odor in the shelter. The dung and urine collected on the bedding material is enriched organic manure. The biological activity in the deep litter system keeps the shelter warm in winter and cool in summer.

Goat farming with stall-feeding can be managed in small yards. It is economical and rewarding enterprise for the small, marginal and landless farmers.

It is of utmost importance to provide exercise paddock for the goats reared in stall fed system. An enclosure measuring 12m x 18 m is sufficient for 100 to 125 goats. Trees giving shade should be planted to provide adequate comfort in summer. Animals should be allowed to roam in the enclosed area for some fixed period so that they can breath sufficient fresh air and exercise.
Goats are robust animals having resistance to many diseases. Still they are to be vaccinated against foot and mouth disease, pests and tetanus regularly. They have to be de-wormed twice in a year to keep them in good stead.

11.6 MANAGEMENT AND BREEDING OF GOATS

Take care of goats by always monitoring their activities. Healthy goats and weak goats should be kept separate and necessary treatment should be provided to the weak goats. Vaccinate the goats in time prevents the unwanted problems and keep the goats healthy and productive. Prevent the goats from going out side the farm area. Always feed the goats fresh and nutritious food along with sufficient amount of green elements. Special care has to be taken of breeding bucks and does.
Modern and well-established scientific principles, practices and skills are to be used to gain maximum economic benefits from goat rearing.

Management of goat's shelter (goats house) –

Shed should be constructed on dry and properly raised ground. Avoid water logging and marshy areas for the shed. Floors should be elevated in heavy rainfall areas and low-lying areas. The shed should be 10 ft. high and good ventilated. Does should be housed in groups up to around 60 per pen, while bucks should be housed in individual pens. Proper shade and cool drinking water should be provided for the animals in summer. Dung and urine should be disposed properly. Adequate space should be provided for the goats so as to avoid over stocking or crowding.

Selection of Goat Breeding Stock and its Management –

A veterinary doctor and bank's technical officer should be consulted before purchasing the animals. The animals to be purchased should be in good health and have good physical features. Animals that are ready to breed and in the prime stage of production should be purchased. Suitable identification mark should be there to identify newly purchased animals. The newly purchased animals should be vaccinated against the diseases. The newly purchased animals should be kept separate and observed for 15 days before mixing them with the general flock. Unproductive

animals should be identified and replaced by the animals that are farm born or by newly purchasedones. Bred the animals at an interval of 8-9 months for maximum productivity. The kidding should be avoided during peak periods of summer and winter. The old animals should be culled at the age of 6 years and above.

Goat Diseases and its Management –

If illness is suspected consult the nearest veterinary aid center. The farmer has to be alert for any signs of illness. If the animals have reduced the food intake, having fever, abnormal discharge or any unusual behavior is seen in the animal, immediately consult the nearby veterinary doctor. The animals should be protected from common diseases. Segregate or separate the sick animals immediately from healthy ones and take necessary measures for disease control in case of out break of contagious diseases. Regularly deworm the animals. Examine the faeces of animals to detect eggs of internal parasites. If found treat the animals with suitable drugs. To minimize the health disorders and illness provide clean and pure and uncontaminated feed and water to the animals. The animals should be vaccinated regularly as per the vaccination schedule program. The common diseases found in goats are Mastitis, Foot Rot, Brucellosis, Internal Parasites, External Parasites, Poisoning and Bloat.

11.7 FEEDING MANAGEMENT OF GOATS

Goats are very active eaters and easily cover large areas in search of their favorite plants. It is for them to pick the most nutritious plant parts in the form of small leaves, fruits and flowers because of their split upper lips and small mouths. Goats do not eat everything that come in front of them. They reject all materials that are low in quality. They select only those grasses, which have high protein content and are easy to digest. They chose both warm and cool season grasses and legumes for foraging over bush and weeds.

Bushes and shrubs should be there for the animal browsing, and supply of cultivated fodder from own farm or from surrounding farms must be ensured. Offer roughages adlib so that this meets 2/3 of the energy requirements. Half of the roughages should include leguminous green fodder and the remaining half should be grass and tender tree leaves.

Concentrates must be provided if there is no good quality green fodder. The kids should be fed colostrum up to 5 days and later on kid’s starter rations. From 15 days onwards the kids should be given green leguminous fodder. Salt and water is to be given at

all times. During breeding season the bucks and does should be given additional concentrates. All the necessary nutrients should be provided to the animals for proper growth.

Under Stall Fed Conditions –

If the goats are totally stall-fed they should be provided with around 3-4 kg of green fodder, 1-2 kg of dry fodder and 200-250 gms of readymade seeds as concentrates. If the goats are partially stall-fed and partially free range, then feed the goats with 50% of the above quantities in the stall. The kids should be allowed to suckle enough colostrum in the beginning, for their natural immunity. Supplementary special kid ration should be started for the kids after 10 to 12 days of birth but milk feeding should be continued up to 2.5 to 3.0 months. Adult goats should be given green leaves of shrubs like Subabhul, Shewari, Pangara, Anjan, Babul beans.

Preservation of Green Forage Crop –Silage

Silage is the foodstuff for goats prepared by preserving green forage crops by acidification. It has two phases aerobic phase and second anaerobic phase. The aerobic phase occurs in presence of oxygen. Oxygen present in the forage is consumed; by the plant material through the process of respiration. Excessive aerobic fermentation reduces energy content of the silage. It might cause heat damage to proteins.

The anaerobic phase begins when available oxygen is used up by respiration and aerobic bacteria cease to function. The anaerobic bacteria multiply and the fermentation process begins. Fermentation completely ceases after 3 to 4 weeks. The pH becomes very low, as a result all the microbial growth is inhibited.
To enhance the feed quality and reduce spoilage limited air should be present in the silage. Silage density increases with increasing moisture content, shorter cut length packed silage depth and amount of packing.

Feeding Management
The different goat rearing systems are as follows-

1) Extensive Grazing System-

In extensive system of grazing the goat are left in the entire pasture for grazing for the whole season. Feed cost is much reduced in this system. It is not conducive to make the best use of the whole grasses. So it is suggested to practice rotational grazing method.

Rotational Grazing System-

In rotational grazing system the pastureland should be divided into several sections by temporary fences. The goats are then moved from one section to another section. By doing this the first section will have sufficient grass cover to provide for second grazing by the time the entire pasture is grazed. In this system of grazing parasitic infestations are controlled to a great extent. It also helps to provide quality fodder for most of the year.it is suggested to graze the lambs first and then bring in ewes to finish the feed left by the kids.

2) Semi-Intensive System of Grazing-

It is an intermediate compromise between extensive and intensive system of goat grazing followed in some flocks having limited grazing. It involves extensive management with controlled grazing of fenced pasture. Stall-feeding, shelter at night under shed and 3-5 hour grazing and browsing on pasture is the provision in this system of grazing. Feed of cost is increased in this system.

Advantages of Semi-intensive system of grazing-

The requirement of nutritious food is fulfilled both from grazing and stall-feeding. Medium to large flocks of 50 to 350 heads and above can be managed in this system. Cultivated forage is utilized during the lean period. Harvesting of good crops for kids both for meat and milk is possible. As less labor is required more profit can be gained.

3) Intensive System of Grazing-

It is also called as zero grazing system. In this system the goats are continuously kept under housing confinement with limited access in which they are stall-fed. Here the goats are not left to fend themselves with minimum care. This system requires more labor and more cash input. But the advantage of this system is that the animals can be closely supervised and animals can be controlled. This system makes use of the dung as a good fertilizer. More number of animals can be adjusted in less space.

4) Rearing in Mud Floor-

Once in a year 1-2 inches of mud surface should be removed in this method. The disease occurrence in the shed will be reduced with the application of lime powder once in a month. To prevent water stagnation shed should be constructed in elevated area.

5) Rearing in Deep Litter Shed-

The animals in this system are reared on the litter materials like groundnut husks, sugarcane tops etc. are spread on the floor for a depth of ½ feet. The urine and dung mixed with the litter material are used as fertilizer. Once in six months the litter material

should be removed. The litter material should not be over wet in heavy rain, as this would cause the production of ammonia gas.

6) Rearing in Elevated Floor Shed-

The initial investment in this system is high. The animals are reared in the wooden floor sheds in a distance of 3m from the floor. This system requires less labor, but for fodder production more irrigated land is required. The elevated sheds will be clean. The urine and dung will be collected on the floor. This requires periodical removing once in six months.

Feeding different age groups of goats-

A) Feeding does in different stages

a) Feeding of breeding does – There is no need of supplement concentrate mixture if good pasture is available. But in poor grazing conditions animals should be supplied with concentrate mixture in proportion of 150 – 350g of concentrate per animal per day depending on the age. The digestible crude protein level of concentrate mixture used in the adult feed is 12%.

b) Feeding does during the first four months of pregnancy- Grazing in good quality pasture for 4-5 hours per day should be allowed in pregnant animals and they should be supplemented with available green fodder at the rate of 5kg per head per day.

c) Feeding the does during the last month of pregnancy- In this period the fetal grows by 60-80%, so the animals should be allowed to graze in very good quality pasture for 4-5 hours per day. Or else due to parturition and lack of energy in the feed can cause pregnancy toxaemia in does. The animals also should be fed with concentrate mixture at the rate of 250-350g per animal per day. Their ration should be also supplemented with green fodder at the rate of 7 kg per head per day.

d) Feeding the does at the kidding Time- Soon after kidding the doe must be given enough slightly warm water. Immediately after kidding the grain allowance should be reduced but good quality dry roughage is fed. Usually it is preferred to feed lightly on the day of parturition, but allow plenty of clean and cool water to drink. After parturition the ration of the doe can be gradually increased so that she receives full ration with bulky and laxative feedstuff in divided doses during the first few days.

e) Feeding Lactating Does - They should be given 6-8 hours for grazing along with 10 kg cultivated green fodder per day, 400g of concentrate mixture per day, 800 g of good quality legume hay per day.

f) Feeding Non Pregnant Does – There is no need to give concentrate mixture if the availability of pasture is good but if not there then the animals should be supplemented with 150-200 g of concentrate per animal per day.

B) Feeding Bucks for Breeding - Usually the common practice is to allow the bucks to graze with the does so that he also gets the same ration as the does. This will meet the nutritional requirements of the buck.

C) Feeding the kids

a) Feeding the kids from birth to three months of age- Feed the young ones with colostrum immediately after birth. The young one and the dam should be kept together for 3-4 days so that the young one has frequent access to milk. But after that up to weaning feed the kids for 2-3 times a day with milk. As the kid is about 2 weeks of age it should be trained to eat green roughages. It should be provided with the concentrate mixture (Creep Feed) at the age of one month up to 2-3 months of age. The creep feeding gives more nutrients for the rapid growth of kids.

b) Feeding after 3 months to 12 months of age- The kids should be allowed to graze in the pasture for about 8 hours per day. They should be supplemented with concentrate mixture with protein of 16-18 % at the rate of 100-200g per animal per day. They should be given dry fodder at night in summer months and during rainy days.

11.8 SUMMARY-

Goat is a multifunctional animal it plays an important role in the economy and nutrition of rural landless, small and marginal farmers. Goat rearing is practiced on large scale in rural India. Goats are kept as a source of additional income and as an insurance against disasters and calamities. Goats can survive on available shrubs and trees. In India goats are used during the ceremonial feastings and they also have religious and ritualistic importance in many societies. Increasing demand of goat meat and milk in India is a hope for widely spreading this industry.

11.9 QUESTIONS FOR SELF-STUDY:

1) What are the advantages of goat rearing?
2) Name the different breeds of goat in India.
3) Write in detail goat rearing and integrated farming system.
4) Discuss management and breeding in goats.
5) Feeding management of goats- discuss.
6) Discuss the feeding management and different goat rearing systems in India.
7) Answer in short the feeding of different age groups of goats.
8) Write short note on:
   a) Exotic breeds of goat
   b) Stall fed farming

12

SHEEP REARING

Unit Structure :

12.0 OBJECTIVES

1) To know the importance of sheep rearing
2) To study the advantages of sheep farming
3) To study the scope for sheep rearing
4) To study the different breeds of sheep in India
5) To study the different sheep rearing systems
6) To learn the diseases in sheep's and their remedies

12.1 INTRODUCTION

Sheep farming is one of the traditional business and occupations of the people in many countries around the world since ancient times. Sheep farming means rearing sheep's at commercial level, for the purpose of meat, milk and wool production. In short sheep rearing is the raising and breeding of domestic sheep. With proper facilities sheep can be raised on small and large scale. Sheep can be reared as free range or under housing inside a shed. It is an important of dry land farming system. With very low investments it can be made a profitable venture for small farmers, marginal farmers and landless laborers. Commercial sheep farming business is very profitable, as investment is repaid in a short period. Sheep with its multi-facet utility for wool, meat, milk, skins

and manure, form an important component of rural economy particularly in the arid, semi-arid and mountainous areas of the country. Through sale of wool and animals, it provides a dependable source of income to the shepherds.

12.2 IMPORTANCE OF SHEEP FARMING

Sheep are raised mainly for their wool, milk, skins and manure production. Sheep meat is popular in all types of people throughout the world as it is very tasty and nutritious. Mutton is one kind of meat, towards which there is no restriction by any community in India and further development of superior breeds for mutton production will have a great scope in the developing economy of India. It is a reliable source of income for the people engaged in animal farming business. Sheep farming is a great source of income and can eradicate poverty from the barren, desert, semi-arid and mountainous areas. Sheep in India are mostly maintained on natural vegetation on common grazing lands, wastelands and uncultivated (fallow) lands, stubbles of cultivated crops and top feeds (tree lopping). They are rarely kept on grain, cultivated fodder or crop residue. The productivity of Indian sheep is lower than those of agriculturally more advanced countries. But their productivity cannot be considered as inefficient considering their nutritional and physical environment. The major reasons for the low productivity of sheep are inadequate grazing resources, diseases causing high mortality, morbidity and consequent reduced production, and serious lack of organized effort for bringing genetic improvement. Sheep are mostly reared for wool and meat. Sheep's skin and manure constitute important sources of earning. Milk from sheep is of limited importance so Indian sheep is not regarded as dairy sheep. A number of rural-based industries use sheep's wool and skin as raw material. Sheep manure also is an important source of soil fertility.

Sheep farming and its advantages:

1) Sheep farming can be started using small capital.
2) A small and simple house is sufficient for the sheep.
3) Less labor is required for sheep farming business than any other livestock business.
4) As sheep's reproduce in a short span the foundation stock is relatively cheap and the flock can be multiplied rapidly.
5) Sheep can be used for cleaning unwanted plants from the garden or field as they eat different kinds of plants.
6) Sheep hardly destroys trees and plants.

7) Sheep are economical converter of grass into meat and wool and eat varied kinds of plants compared to other kind of livestock. This makes them excellent weed destroyer.

8) Products obtained from sheep are used for different purposes. The production of wool, meat and manure provides three different sources of income to the shepherd.

9) Sheep can adapt themselves to almost all types of environment, as they are very strong and hardy animal.

10) Sheep can be raised with other livestock animals, as they require less space for living.

11) Proper management and care in commercial sheep farming creates employment and a good source of income for the unemployed educated youths.

12) Commercial sheep farming can play an important role in the national income of the country.

13) There is an opportunity to earn foreign exchange as the sheep products have a huge demand in the international market.

14) Export of sheep products can increase national income.

12.3 SCOPE FOR SHEEP FARMING

The contribution of sheep to total meat production in the country is more than 14% and the contribution of sheep through export of meat is more than 8% of the total export value of agricultural and processed food products. Live sheep are also exported for meat purpose. Sheep's skin also is exported in the form of leather and leather products. Amongst the livestock owners shepherds are the poorest and sheep make a valuable contribution to the livelihood of this section. The Central Government had established the Central Sheep and Wool Research Institute (CSWRI) in Rajasthan on realizing the importance of sheep in Agrarian economy. Many sheep breeding farms were established during various plan periods throughout the country. Sheep development activities were initiated under the programs like DPAD, MFAL, SFDA, ISDP's. Setting up of wool boards in important wool producing states was envisaged. Some states have set up wool development corporations and federations.

12.4 INDIAN BREEDS OF SHEEP

There are around 40 breeds of sheep in India out of which 24 breeds are distinct. The breeds vary from the non-woolly breeds in the southern peninsular region usually kept for mutton and manure. Apparel wool breeds are reared in the northern temperate region. There are no specific breeds in a strict sense if we classify

the sheep breeds. Majority of breeds lack characteristics of a fixed nature.

Animals having distinct characters localized to a place and different from those of other places are termed as breeds and are given some local name.

There are neither breeding societies nor agencies to register animals of a particular breed, maintain flock books and ensure purity of the breeds. Very little efforts have been made to conserve and improve the native breeds other than government farms. Only a few important breeds of sheep are maintained for pure breeding and producing stud rams for distribution to the farmers. In India most of the breeds of sheep have evolved through natural adaptation to agro-ecological conditions and limited artificial selection for particular requirements. Generally most of the breeds have been named after their place of origin and on the basis of their prominent characters. Among the most widely distributed native sheep breedsmost prevalent are Marwari and Deccan.

Sheep are contributing much to the India's economy and are used for producing cloth, carpet and mutton.

The available sheep breeds in India are as follows:-

A) Sheep Breeds in Eastern Region-

1) Balangir- It is an important sheep breed in eastern regions of India. They are light brown in color with short ears and knobby. Their fleece is extremely coarse. This breed is mainly raised for its wool and mutton.

2) Tibetan- This breed is popular for producing beautiful wool, which is used for manufacturing carpet.

3) Bonpala- Fleece from this sheep is also used for making carpet. The fleece of this sheep is black or white.
Ganjam, Garole and Chottanagpuri are also the breeds available in the eastern region of India and they are mainly raised for mutton.

B) Sheep Breeds in the Northern Region-

1) Gaddi- It is a popular sheep breed in northern region of India. This breed is of medium size with short and flat tails. Generally the fleece color is white but black, brown or tan color wool is also seen in Gaddi sheep. The two types of sheep breeds originated from Gaddi are Kashmir and Merino sheep. The fleece produced by these sheep is of good quality and is considered as one of the

finest wool in the world. The fleece is used usually used for cloth production.

2) Bakharwal- This is an endangered species of bred available, but only a few numbers is available.

The other sheep breeds available in the northern region are Changthangi, Karhah and Gurez. Wool from Changthangi and Gurez sheep is used for making carpets and wool from Karhah is used as apparel wool.

C) Northwestern Region-

1) Magra- This sheep is very popular breed and highly available in the Bikander district of northwestern region of India. This breed produces high quality and extremely white wool, and their wool is used for producing fine carpet. Magra ewes can be bred only after 18 months of their age, and they produce only one kid at a time per lambing.

2) Chokla- This breed has dense coat and hairless faces.

3) Marwari- This sheep has long legs, black face and a prominent nose. Tail is short and pointed. Fleshy appendages under throat, known as wattles are often present. This breed is hardy, yielding coarser carpet variety white wool of mixe hairy composition. They are highly resistant to worms and diseases.

The other important breeds available are Sonadi, Kher, Jalauni, Jaisalmeri, Pugal, Marwari, Malpura etc. These breeds are suitable for both carpet wool and mutton production.

D) Southern Peninsular Region-

1) Deccani- This breed is very popular in the southern peninsular region of India. As this breed is very hardy it can adapt itself well with the extreme temperatures of the southern region. They are mainly raised for mutton production.

2) Madras Red- It is also raised for mutton. The fleece of this breed is usually brown in color and extremely short.

3) Mecheri- It is found in Salem, Karur, Erode, Namakkal and some parts of Dharampur districts of Tamilnadu. It is medium sized having pale purplish skin color. There are no horns for both the sexes. Their tail is smaller and slender.it is a meat purpose breed.

4) Neelagiri- They are found in Neelagiri district of Tamilnadu. They are medium weighing animals. Majority of sheeps are found in

white color, but certain sheeps are found with purple spots on their body and face. Their ears are broad and drooped out. Females do not have horns. This breed is for wool purpose.

5) Tiruchi Black- They are distributed in Tiruchi, Perambalur and Salem districts of Tamilnadu. These are smaller breeds with black color all over the body. Ears are small facing forward and downwards. Adult males have horns and female without horns. It is wool purpose breed.

6) Nellore-This breed is found in Nellore, Prakasam and Ongole districts of Andhra Pradesh. This breed is tall with little hair except at brisket, withers and breech. They have long and drooping ears. It is the tallest breed of sheep in India. They resemble to goats in India. It has along face and long ears with the body densely covered with short hair. Majority of animals carry wattles. Majority of flocks are fawn or deep red fawn color. In this breed rams are homed and ewes are polled.

7) Mandya-This breed is found in Mandya district of Karnataka. They are small animals white in color. Sometimes face is light brown in color and may extend up to the neck. This breed has a compact body with typical reversed ”U” shaped conformation from the rear. Their ears are long, leafy and drooping. Both the sexes are polled. This breed is the best for mutton among the Indian breeds.

The other breeds available in the southern region are Vembur, Nellore, Nilgiri, Hassan, Tiruchy Black, Rammand White, Mandya, Mecheri, Kilakarsal, Kanguri, etc. all these breeds are raised for mutton production.

Indian breeds of sheep based on utility can be classified into the following:-

1) Apparel wool breeds: Hissasrdale, Nilgiri, Kashmir Merino, Avivastra, Bharat Merino are crossbreds of native sheep with dual-purpose exotic fine wool and mutton breeds.

2) Superior carpet wool breeds are Chokla, Nali, Magra, Jaisalmeri, Pugal, Patanwadi, Tibetan, Bonpala, Gaddi, Rampur Bushair, Poonchi, Karnah, Gurez, Changthangi, Avikalin.

3) Coarse carpet wool breeds are Malpura, Sonadi, Muzaffaranagari, Jalauni, Deccani, Bellary, Coimbatore, Chhotanagpuri, Balangiri, Ganjam, Bhakarwal, Shahabadi

4) Hairy meat breeds are Nellore, Hassan, Mecheri, Kilakarsal, Vembur, Ramnad White, Madras Red, Tiruchi Black, Kenguri. The

sheep's are maintained primarily for meat production in the Southern Peninsular region. The wool produced is very coarse, hairy and colored; which is suitable only for extremely rough carpets, barrack blankets and kamblies.

All the above breeds are suitable for different production purpose, but are not suitable for commercial production. For commercial sheep farming business the following sheep breeds are considered Bannur, Bellary, Cheviot, Deccani, Hassan, Merino, Ramboullet, South Down.

12.5 EXOTIC SHEEP BREEDS ARE-

1) Dorset- This is a native of U.K and are polled and horned. Its face, ears and legs are white in color and is free from wool. It produces mutton of superior quality. It is a hardy breed capable of performing well under most of the conditions.

2) Suffolk- This is also a native of U.K. It is a large animal with black face, ears and legs. Its head and ears are entirely free from wool. Rams and ewes are polled. Ewes are very prolific and excellent milk giving animals. This breed, when imported to India, has performed poorly than the Dorset's.

3) Merino- This is the most popular fine wool breed of the world. It was originated in Spain. This breed is extremely hardy being able to survive under adverse weather and poor grazing conditions. It is white-faced sheep with white feet and most of the head and legs are covered by wool. Rams have horns and ewes don't have horns. The ewes of this breed live and yield longer than any other breed.

4) Rambouillet- This breed was developed in France. It has large head with white hair around the nose and ears. Rams have horns and ewes don't have horns. Excellent fine-wool fleece is produced by this breed. The fleece of this sheep breed is heavy, close, compact, and covers most of the body including face and legs.

5) Cheviot- This breed was primarily developed in Scotland. It is amedium wool breed. It has small erect ears, clean white face and white legs covered with short white hair, but the nose, lips and feet are black.

6) Southdown- This is one of the oldest English breed and has greatly contributed to the development of many other breeds of sheep. This small sheep is excellent for mutton production. Its body is low-set, compact, wide and deep with legs wide apart. It has broad head and face is light brown colored.

12.6 REARING OF SHEEP

The different sheep rearing systems are as follows-

1) Extensive Grazing System-

In extensive system of grazing the sheep are left in the entire pasture for grazing for the whole season. Feed cost is much reduced in this system. It is not conducive to make the best use of the whole grasses. So it is suggested to practice rotational grazing method.

Rotational Grazing System-

In rotational grazing system the pastureland should be divided into several sections by temporary fences. The sheep's are then moved from one section to another section. By doing this the first section will have sufficient grass cover to provide for second grazing by the time the entire pasture is grazed. In this system of grazing parasitic infestations are controlled to a great extent. It also helps to provide quality fodder for most of the year. It is suggested to graze the lambs first and then bring in ewes to finish the feed left by the lambs.

2) Semi-Intensive System of Grazing-

It is an intermediate compromise between extensive and intensive system of sheep grazing followed in some flocks having limited grazing. It involves extensive management with controlled grazing of fenced pasture. Stall-feeding, shelter at night under shed and 3-5 hour grazing and browsing on pasture is the provision in this system of grazing. Feed of cost is increased in this system.

Advantages of Semi-intensive system of grazing-

The requirement of nutritious food is fulfilled both from grazing and stall-feeding. Medium to large flocks of 50 to 350 heads and above can be managed in this system. Cultivated forage is utilized during the lean period. Harvesting of good crops for kids both for meat and milk is possible. As less labor is required more profit can be gained.

3) Intensive System of Grazing-

It is also called as zero grazing system. In this system the sheep's are continuously kept under housing confinement with limited access in which they are stall-fed. Here the sheep's are not left to fend themselves with minimum care. This system requires more labor and more cash input. But the advantage of this system is that the animals can be closely supervised and animals can be controlled. This system makes use of the dung as a good fertilizer. More number of animals can be adjusted in less space.

4) Rearing in Mud Floor-

Once in a year 1-2 inches of mud surface should be removed in this method. The disease occurrence in the shed will be reduced with the application of lime powder once in a month. To prevent water stagnation shed should be constructed in elevated area.

5) Rearing in Deep Litter Shed-

The animals in this system are reared on the litter materials like groundnut husks, sugarcane tops etc. are spread on the floor for a depth of ½ feet. The urine and dung mixed with the litter material are used as fertilizer. Once in six months the litter material should be removed. The litter material should not be over wet in heavy rains as this would cause the production of ammonia gas.

6) Rearing in Elevated Floor Shed-

The initial investment in this system is high. The animals are reared in the wooden floor sheds in a distance of 3m from the floor. This system requires less labor, but for fodder production more irrigated land is required. The elevated sheds will be clean. The urine and dung will be collected on the floor. This requires periodical removing once in six months.

12.7 FEEDING MANAGEMENT

High quality and nutritious food keeps the sheep's healthy, disease free and productive. Always feed fresh and nutritious food to the animals. Sheep's eat all types of green grasses, plants and almost everything edible that comes in front of them. Provide the sheep's with sufficient amount of clean and fresh water along with the provision of good food. The feeding and grazing conditions vary from place to place. The most suitable and favorable time for grazing is the onset of monsoon till the onset of winter. During summer the grazing resources become very so during this period supplementary feeding is necessary. Attention should be given to pasture improvement and management as sheep thrive well on pasture. Rotational grazing should be followed to ensure availability of good pasture all the time. Rotational grazing helps to avoid worm infection and unthriftiness. Conserve the fodder for the lean period in the form of hay and silage. Plant fodder trees in the pasture as it provides shade and fodder in the lean period. Depending on the physiological status and availability of grazing resources in the pasture concentrate on the supplementary feeding.

Water:

Depending on the physiological status and temperature in different seasons water requirement of the sheep also vary. At least once a day the sheep should be given water at the rate of 2-3 litres

per head per day. The younger ones requirement is 1-2 litres of water everyday. But the cross-breeds requirement of water is 5-6 litres per day during the summer. Sheep breeds from the arid region have good adaptation to water restriction. The flock should be weighed at least once in a week.

Feeding lambs up-to two weeks- Ewe's milk is the best food for lambs for their early growth and rapid gain. Lambs depend totally on dam's milk for two weeks. Colostrum contains antibodies, which protect the lamb from infections and is also rich in fat, protein and vitamins, etc. to enhance the milk production in ewes they are to be fed good ration during the last six weeks of gestation.

Feeding to suckling ewes- Ewes should be fed good milk producing rations during the suckling period. Good legume hay with little or no grain should be fed to the ewe for a week. The amount of grains can be increased after she is milking freely and her bowels are free showing no sign of constipation. Hay is not needed, if pasture is available.

Feeding adult sheep- Suckling ewes must be fed with 150gms of concentrate with mineral mixture and salt, while the roughage part is taken care by grazing.

Feeding Breeding Rams- Breeding rams are to be fed with good quality green fodders like maize, cowpea, doob grass, berseem, etc. as they meet all their requirements. 150-200 gms concentrate should be given to the rams if the forages fed are of poor quality like straw or sorghum hay.

Feed for kids		**Feed for adults**	
Broken maize	22%	Broken maize	37%
Broken gram	20%	Broken gram	15%
Almond cake	35%	Almond cake	25%
Wheat	20%	Wheat	20%
Mineral salt	2.5%	Mineral salt	2.5%
Salt	0.5%	Salt	0.5%

12.8 DISEASES FOUND IN SHEEP AND THEIR REMEDIES

Sheep can be infected by a variety of infectious and noninfectious diseases. The diseases contagious to people are called zoonotic diseases or zoonosis. As certain diseases prevent

the import and export of livestock the government authorities must be reported. The basic thing to the production of sheep's is a sound management program to keep animals healthy. The producers should observe the animals closely, so that the individual and the whole herd or flock remains healthy and productive. There should be no compromise in dealing with the health of animals. Dealing with the diseased animal will pose some human health risk. Not all the sheep diseases cause problems, but some zoonotic diseases cause problems not only to the caretakers, but also to those who come in contact with them.

Common Diseases and Their Control

The two important factors resulting in heavy losses in the sheep production and their improvement programs are Morbidity and Mortality. Prevention is better than cure perfectly applies to the sheep as they respond less to the treatment given when sick.

A) Non-Infectious Diseases

Approximately 80% of deaths in sheep have occurred due to non-infectious diseases. The major causes reported are starvation, mismothering and behavior, nutritional and environmental stress, reproductive problems and predation.

1) Pneumonia- It is the most common and important pathological conditions in sheep. It is characterized clinically by increased respiration, coughing and abdominal breathing. If some fluid by mistake enters the animal's respiratory tract, its head should be lowered immediately and slapped a few times.

2) Ruminal Tympany (Bloat)- This is generally seen in "greedy feeders" when lush green pasture is available. Bloating occurs due to over-distention of the left flank either due to free gas or froth. Tie a bitter (neem) stick in the mouth to increase the secretion of saliva. Oral administration of sweet oil with turpentine oil or at times formalin is advisable.

3) Rumen Acidosis- An acute illness dueto excess production of lactic acid in the rumen cause ingestion of large amounts of highly fermentable carbohydrate feeds. Normal saline, sodium bicarbonate and anti-histaminics are advised.

4) Intussusception- It occurs commonly due to nodular worms, change in feed and local intestinal problems. Emergency surgery is the only option.

5) Deficiency Diseases- The deficiencies of cobalt, copper, calcium, phosphorous, vitamin D and A are to be treated with mineral diet supplement, green pasture and copper and cobalt sulphate.

6) Pregnancy Toxaemia (Ketosis)- This disease is caused due to lack of nutrition and short periods of starvation (40hrs) during the last two months of pregnancy. Treatment comprises of intravenous administration of 50% glucose, supply of molasses in the food and additional concentrate to be provided in the last two months of pregnancy. The other disease include poisoning due to the pesticides used on crops, snake bite, wounds during the monsoon season.

B) Infectious Diseases

1) Blackleg- This is an acute infectious disease and takes place through skin wounds. Penicillin is used for treatment.

2) Enterotoxaemia (pulpy kidney) – It is an acute disease and affects animals in a high state of nutrition on a lush feed, grass or grain. Can be treated with Suphadimidine. Reduction in feed intake and vaccination are the two other major controls.

3) Tetanus- Is an acute infectious disease of the voluntary muscles. Common routine operations like shearing, docking, castration and even vaccination is followed. Tetanus antitoxin is administered.

4) Pasteurellosis- It occurs by the inhalation or ingestion of the infected material.Preventive vaccination is advised.

5) Paratuberculosis (Johne's disease)- It is a chronic disease seen in older animals. No treatment is successful.

6) Sheep Pox – It is a highly contagious viral disease spread by contact with infected animals and contaminated articles or by inhalation. Vaccination is the best control.

7) Foot and Mouth Disease- It is an extremely contagious acute viral disease. Antibiotics are recommended but vaccination is the best control.

8) Contagious Ecthyma- It is a viral disease and antibiotics are suggested to check secondary infections.

9) Blue Tongue- It is an infectious but non-contagious exotic disease of sheep. Antibiotics are recommended to check secondary infections.

12.9 SUMMARY

Sheep farming is one of the traditional business and occupations of the people in many countries around the world since ancient times. Sheep farming means rearing sheep's at commercial level, for the purpose of meat, milk and wool production. In short sheep rearing is the raising and breeding of domestic sheep. With proper facilities sheep can be raised on small and large scale. Sheep with its multi-facet utility for wool, meat, milk, skins and manure, form an important component of rural economy particularly in the arid, semi-arid and mountainous areas of the country. Through sale of wool and animals, it provides a dependable source of income to the shepherds.

12.10 QUESTIONS FOR SELF-STUDY:

1) Give the importance of sheep rearing in India and give its scope and advantages?
2) Write in detail the Indian breeds of sheep.
3) Discuss the different sheep rearing systems in India.
4) Answer in brief the feeding management in sheep's.
5) What are the different diseases found in sheep's and what remedies are suggested?
6) Write short note on Exotic breeds of sheep.

13

POULTRY-I

Unit structure :

13.0 OBJECTIVES

1) To review the poultry occupation
2) To acquaint with the traditional and cross breed birds.
3) To know the scientific techniques used to rear the birds.
4) To provide information about poultry products.
5) To understand the importance of poultry in rural development.
6) The role of poultry as a source of employment.

13.1 INTRODUCTION

Poultry farming is the raising of domesticated birds like chickens, ducks, turkeys, and geese for the purpose of meat or eggs for food. Poultry are farmed in great numbers with chickens being the most numerous. More than 50 billion chickens are raised annually as a source of food (both meat and egg). Poultry keeping, in India, has for a long time remained a rural cottage enterprise. The common village hen receives very little attention and care. As a result its productivity also is low. But now poultry is one of the fastest growing segments of the agricultural sector. The production of eggs and broilers has rose at a rate of 8-10% annually. As a

result, India was the fifth largest egg producer and the eighteenth largest producer of broilers in the world.

The poultry sector in India has undergone a total change in structure and its operation. A significant feature of India's poultry industry is its transformation from a mere backyard activity to a major commercial activity in a very short span of four decades.

Sizeable investments in breeding, hatching, rearing, and processing has involved in the transformation. Indian farmers have started to rear hybrid birds ensuring faster growth, good livability, excellent feed conversion and high profits to birdrearers. The growth in the Indian poultry is due to the initiative of private enterprises, minimum government interference, considerable indigenous poultry genetics capabilities and great support from the veterans, poultry feed, equipment, and the processing industries. India is one of the very few countries in the world that has put into place a sustained Specific Pathogen Free (SPF) egg production project.

13.2 CONCEPT

Even though poultry development has done very well during the last three decades, the growth has been restricted to commercial poultry. Rural backyard poultry contributing nearly 30% to the national egg production is still neglected. Private poultry producers are not able to attend the needs of rural consumers. The private commercial sector is reluctant to enter the rural backyard poultry sector as they aim for higher and quick profits, through large investments. The commercial poultry sector has adopted integrated approach of contract farming. They use high input and high out put birds.

The fact that a fairly significant proportion of the landless and marginal farmers make their living from poultry and other animals like cow, buffalo, goat, sheep, etc. Using poultry as a tool; small farmers, marginal farmers and landless labor families can be enriched not only in terms of income raising, employment generation, nutritional status, fostering community development, gender empowerment and environment protection.

13.3 SCOPE

Poultry industry in India has undergone change during the last three decades. Initially it was considered only as a backyard activity. But suddenly due need of employment and income in the rural areas rural youth turned their attention to this activity. They learned the new techniques and other processes in the poultry

activity. Now it is one of the most successful; income generating occupation. Now India is the 5th largest producer of eggs and ninth largest producer of poultry meat. India was well positioned at the 18th place in the world poultry production. There is an overwhelming response from all fields that are related and concerned with poultry activity. A strong platform for poultry in India has been created and is experimenting with new techniques and innovations for processed chicken meat, medicines, feed additives, health products, related equipment's, management of the poultry industry and other technical services.

13.4 METHODS OF BREEDING CHICKEN

Different basic methods of breeding are out and out breeding, flock sourcing, flock mating, rolling mating, and spiral mating.

Out and Out breeding – It is simply a system of bringing in new roosters from different sources every year. This system is also used in pure bred flocks- same breed roosters are sourced every year, but source is changed every year. Here all females can be maintained as one flock. But it is difficult to manage productive traits as the source flocks for the roosters will each be strong in some traits while it will be weak in others.

Flock Sourcing- In this method also new rooster is brought every year. The advantage is improvement of traits overtime, relying on the efforts of the master breeder, and the retention of known good qualities. The disadvantage is that one has to rely on someone else for quality new roosters.

Flock Mating- It is a method in which flock of chicken are bred as one unit. Here the ratio is 20 males to 180-200 females. The chickens decide who mates whom. This system is commonly used in commercial hatcheries.

Rolling Mating-This method is also known as Old Farmers Method. In this method you have to separate two flocks every year during the breeding season. Some inbreeding occurs in this system, but many birds have little relation to each other. This is a simple system having advantage of requiring only two flocks.

Spiral Mating- In this system three or more matings are setup every year. The rotation or spiral mating comes from males of one family being used only with female of the next family. The advantage of spiral mating is that close relatives are never mated. This can go on many decades without adding new chickens.

13.5 MATING METHODS

The number of females to be mated to each male varies depending on the breed, age, health and sexual activity of the male. The two main methods of mating are Natural mating and Artificial Insemination.

A) Natural Mating – In this method males are allowed to mate with females naturally. This method can be further categorized into:-

1) Pen Mating- A group of hens is allowed to mate with a cock in a pen. The ration of male to female is 1:10 or 12 for light breeds, while it is 1:8 or 10 for heavy breeds. The fertility rate is low due to preferential mating.

2) Flock Mating-
It is a mass mating system where 2 or more males are mated with several females in a single pen. Male to female ratio is 1: 12 to 15 for light breeds and 1: 10 to 12 for heavy breeds. In this method the male bird gets a choice to mate with the female he chooses. The fertility is high, so used in commercial poultry.

3) Stud Mating- In this system the male is kept separately in a coop or a pen and one by one females are put into the coop for mating. More off-springs can be obtained. Here the ratio is one male to many females and the result is high fertility. This system involves more work and labor.

4) Shift Mating- In this system the sires are shifted to breeding pens. By shifting the male, a female can be mated with several males and her breeding worth can be evaluated more precisely. The drawback of this system is the problem of accuracy of the percentage of the progeny. The main advantage of this system that a large number of male can be tested in limited space.

B) Artificial Insemination

Artificial Insemination means the deposition of semen into reproductive tract of female by means other than natural method. In many poultry projects artificial insemination has gained considerable attention. Artificial insemination is extensively used with freshly collected semen in large breeding farms. In this procedure semen from the male is collected and inseminated into the female. It is mainly used in heavy birds whose fertility is generally low in pen mating. It is generally practiced when the flock has an apparent fertility problem. Some training is required on the part of both the operator and male in artificial insemination.

Advantages of artificial insemination in poultry-

1) Efficient use of males can be done as the requirement of males is lesser than compared to natural mating.
2) Production of fertile eggs is possible in cages.
3) Multi locational testing of outstanding sires can be done.
4) Preferential mating and physical incompatibility can be avoided.
5) Accurate recording of pedigree is possible.
6) Fertility is higher by 5-10%.
7) Use of large male with small female and small female with large male is possible.
8) Interspecies hybridization is possible.

Artificial Insemination process includes-

a) Preparation of males.
b) Preparation of equipments required for the collection of semen.
c) Collection of semen from males.
d) Evaluation or testing of semen.
e) Diluting the semen
f) Deposition of semen in vagina of females.

Good results of Artificial Insemination can be achieved by following the steps given below.

1) Avoid any kind of stress to the birds before artificial insemination.
2) For good fertility Artificial insemination should be done twice a week.
3) Insemination should be done when no hard shelled egg is present in the uterus.
4) The intervals between insemination should be maintained.
5) Artificial insemination equipments should be cleaned thoroughly and sterilized before use.

13.6 INCUBATION AND INCUBATION MANAGEMENT

To make poultry raising successful it is necessary to practice good management. The success or failure in the poultry business depends on the man in management. This statement is quite true as other factors are equal.

Incubation can be considered under two headings natural incubation, the hatching of eggs under a hen, and artificial incubation, the hatching of eggs in an incubator. Both types of

incubation are practiced in India. But many would opt for more efficient artificial incubation rather than natural incubation.

A) Natural Incubation

Natural incubation will be practiced in India till there are sufficient incubators and trained hatchery men are available to satisfy the demand for one day old chicks. Chickens are kept for egg production. A broody hen is not profitable unless and until she sits on eggs or brooding chicks. Efforts should be taken to see that the hen sits on as many eggs as possible i.e. 10 to 15 eggs at a time so that the best use of her time is made. At the end of the first week it is possible to see with the candle and discard the infertile eggs. This can be done when several broody hens are set at the same time. The chicks that hatch from two hens can be placed under one mother and the second broody hen can be again made to sit on 10 to 15 more eggs to hatch another brood. One mother hen can take care of atleast 25 chicks if the weather is warm.

The efficiency of natural incubation can be increased; by setting eggs under a broody hen on the same day that your hatchery man sets an incubator. The eggs will hatch at about the same time and the incubator chicks can be placed under a mother hen at night, which she usually adopts.

People object to improved breeds as they seldom become broody. The inherited factor of broodiness is not seen in the improved breeds. So problems may rise when there will be no mother hens to hatch and take care of chicks. In short we can say natural incubation and natural brooding to artificial brooding will create a problem. But the one who wants to commercialize the poultry business will have to practice artificial incubation method.

B) Artificial Incubation

If the poultry business is developed in India like other countries then artificial incubation is likely to replace mother hen.

The benefits of artificial incubation are –

a) Time of hatching can be controlled and there is no need to wait and find broody hens.
b) At a time many chicks can be hatched to meet the poultryman's requirement.
c) Compared to natural incubation improved incubators and trained hatchery men get good and better hatches.
d) Artificial incubation and artificial brooding reduce the hazards of diseases, predators and parasites.

There are two types of incubators-

1) The cabinet type incubators are small.More time is required to keep the temperature adjusted in cabinet incubators.

2) The forced draft types are large. The commercial hatchery men prefer the forced draft type incubator's as they are more efficient. The temperature and humidity controls are automatic and more sensitive in this incubator. In this type temperature variations are less subject to changes with the outside temperature.

Transport of day old chicks to distant places without food is possible, as nature has provided them with sufficient food from the unabsorbed egg yolk to support them for 2-3 days. If the chicks reach their destination in time i.e. within two days they might arrive in good condition. They can be shipped in cheaply constructed bamboo baskets or cardboard boxes. Atleast 20 to 25 chicks should be placed on the dried grass in the shipping bamboo basket to keep them warm.

Factors Affecting Hatchability

Many factors affect the hatchability of eggs whichever method of incubation is used. It is not possible to determine which eggs will hatch and produce a live chick. Following are some factors that affect hatchability.

a) The hatchability is reduced due to high temperatures in many parts of India. So the hatching eggs should be gathered at least four times a day in hot weather and place them in cool and moist places.

b) Eggs laid by pullets hatch better than the eggs laid by older hens.

c) Eggs laid by good layers hatch better than that of eggs laid by poor layers.

d) In-breeding of hens may reduce the hatchability.

e) Hatchability is decreased if the food given to hens is deficient in vitamins A,D, and Riboflavin.

f) Small eggs, extra large eggs, cracked or misshapen eggs, porous or poor shells also reduce the hatchability.

g) If incubators are not regulated or managed properly the hatchability is reduced.

13.7 OBJECTIVES OF POULTRY PRODUCTION

To commercialize the poultry business in India new techniques were used on large scale. Maximum production of eggs and growing broilers in less time was possible due to this technique.

13.7.1 Objectives for egg production :

1) To obtain more production of eggs-

Hens laying maximum eggs are selected for the egg production. The aim is that the hens will lay eggs for a longer period.

2) Disease resistance capacity should be high-

Healthy hens can give increased production of eggs rather than diseased hens having less resistance. So hens are selected having good and high resistance to diseases.

3) Size and weight of the eggs-

From the commercial point of view importance is given to big sized eggs and more weight. A comparative study is done and then the breed is selected.

4) Size and weight of the bird-

Birds small in size and heavy are beneficial from commercial point of view. A comparative study of the production technique is done and then the breed is selected.

5) Requirement of food-

Hens eating less food and giving more eggs would prove profitable. So accordingly such birds are selected for production.

6) Hardness of the shells-

In commercial poultry business eggs are transported to different places. If the eggs shell is hard breakage of eggs can be negligible or very less. The hardness of the shells is because of the inheritance. So such birds having this inheritance are selected.

7) Quality of the egg yolk-

Consumers prefer to buy eggs having big egg yolk. So here also proper selection of birds is very much necessary.

13.7.2 Objectives for Broilers-

1) Maximum growth in less time-

Many batches of broilers can be produced if breeds selected have the qualities of maximum growth in less time. As a result expenses on management and medicines is reduced and can get maximum production.

2) More weight and less food-

The breeds should be such selected who will convert the food eaten into meat in less time. If done so the expenses on food can be less and heavy broilers can be produced. This would be more profitable for the poultry business.

3) More resistance power-

If disease resistant birds are used for production healthy and fit birds can be produced. This will reduce the expenses on medicines and can get good sized and good colored birds, which can give maximum profit.

13.8 ESSENTIALS OF POULTRY FARMING -

a) Capital :

Fixed capital is necessary for the shelter of birds, to purchase equipments and other necessary facilities to be provided for poultry farming. Rotating capital is also necessary to purchase good quality breeds, veterinary facilities and medicines.

b) Space for poultry establishment :

While selecting place for poultry establishment it should be such that there should be no water lodging. Land with slope, soil mixed with sand and water should flow easily is more useful. Big trees should not be there in the vicinity of the poultry farm as the birds sitting on it may be responsible for the spread of diseases. But small trees, bushes are essential as they help to keep the climate cool.

c) Electric Supply :

Modern equipments used in poultry farming require electricity. Also to control the temperature in the shelter or house regular electric supply is a must.

d) Water Supply :

Sufficient water supply is necessary for poultry business. Pure drinking water with good food helps to increase the weight of the birds at a faster rate. For cleanliness of the surrounding area and the shelter water is necessary.

e) High Quality Breeds :

Success of poultry business depends on the good and high quality breeds.

f) Market Facility :

Before starting the poultry farming business it is necessary to see the availability of the market. As eggs are perishable items it has to be seen whether the daily production can reach the market in time. Even for the broilers market availability is a must. If there is no market nearby for the ready poultry products the producer might incurr loss.

g) Scientific Know how :

Hybrid variety of chicken production was started in India in 1962. Last fifty years we have started making use of scientific knowledge in the field of poultry farming. The producer must have the knowledge of different types of poultry breeds, diseases and its remedies and vaccinations available, management technique, food for the poultry birds, techniques of production, poultry birds shelter, scientific technology and available market facility. Changing with the new technology is the key to success of poultry business to gain maximum profit.

h) Food of the poultry birds :

Food of the poultry birds is an important factor of poultry business. Profit and loss in this business is decided on the expenses on food done for the poultry birds. Right management of food means not to waste bird food, giving food to the poultry birds in a balanced manner so that percentage of profit can be increased. Balanced food is to be given to the birds depending on their age and necessity.

i) Medical Supply :

Poultry birds are more prone to disease easily. If after starting the business the birds are infected the percentage of profit minimizes. So the producer always has to be ready with vaccination facility and in case of sudden occurrence of epidemic or disease supply of medicine is an important factor.

13.9 IMPORTANCE OF POULTRY IN RURAL DEVELOPMENT

Rural development is the process of improving the quality of life and economic well being of the people living isolated and thinly populated areas. Rural development actions are mainly aimed for the social and economic development of the rural areas. Rural development aims at finding the ways to improve the rural people with the participation of the rural people themselves so as to meet the necessities of the rural area. The outsider may not understand the life style, culture, language and many other things prevailing in the local area. The main objective of rural development has been to remove poverty and fill the gap between the rich and the poor. Keeping in view the planning policy, various schemes of development, especially agricultural development, the main occupation of the rural people, have been introduced.

Agriculture, with its allied sectors, is no doubt the largest livelihood provider in rural India. It also contributes a vast significant figure to the Gross Domestic Products (GDP).

Poultry farming has occupied an important place in the Indian economy. Poultry farming is playing an important role in the eatery business in India as the fast food culture is growing. It has emerged as the fastest growing segment in the agricultural livestock industry. Poultry industry has not only grown in size but also in productivity. This has been only possible because of the availability of infrastructure facilities, birds, quality feed, modern automatic systems in poultry houses etc. ICAR is playing a vital role in the development of poultry industry.

1) Employment and Self-Employment Generation-

The poultry industry has given rise to many subsidiary industries like compounded feed, equipment, pharmaceuticals, hatchery operation and processing of poultry products. Poultry farming plays an effective role in rural development as it helps the rural population to earn income on regular basis. Poultry dropping is very good manure for crops. It also serves as the source of raw material for industrial products. Poultry keeping provides employment not only for those who are engaged in the production of eggs and chicken meat but also for hatchery operators, feed dealers, building material providers, egg cases and trucks, processors on eggs and poultry products and also the dealers engaged in the marketing of eggs.

2) A part of balanced diet-

Protein deficiency is common in infants and growing children in a large section of the society living below poverty line. India tops in the list of countries facing nutrition problem. Egg is a good source of nutritious food for all ages as it has high protein and is easily digestible. The World Health Organization (WHO) considers egg as the best protein food for humans. This industry in India is recognized as an organized and scientific based industry and also is a potential tool to fight poverty and malnutrition.

3) A business for the poorer sections-

Poultry farming plays an effective role for the rural population to earn a regular income. The inputs required to start this business are locally available. Local artisans in the villages can manufacture the simple equipment’s needed for feeding, watering, and sheltering for small units of poultry business. Even women can be employed in poultry farming as well as in marketing of eggs.

4) Use of barren land-

Land requirement for poultry business is small. Barren land cannot be used for agricultural operations. So this land can be used for poultry farming. As the faeces of the poultry birds has bad smell it is better this business is done on the outskirts of the village. So maximum use of barren land has to be done in this business.

5) Agricultural Subsidiary occupation-

Poultry sector is gaining great importance in India as it meets the growing demand of millions of people. Eggs and poultry meat are less costly, so middle –class people are willing to improve their nutritional standards. Its importance among the rural population has increased due to the growth of manpower in this sector. Urbanization, industrialization, rapid increase in the middle-income population and changing socio-cultural habits, the demand for processed poultry products is increasing fast in India. The urban population has high purchasing power and consumes more meat and eggs. So this business can be done as a subsidiary occupation or as a main business.

13.10 HOLISTIC APPROACH TOWARDS POULTRY FARMS

1) Rural Production and Social Organization-

There were some limitations in the centrally sponsored scheme " Assistance to State Poultry Farms" which was a step towards boosting rural poultry production. The scheme will cater to intermediate rungs of poultry farmers who will rear the chicks in the mother units and also help in providing the backyard poultry rearer with 4-8 week old reared chicks so as to minimize the high chick mortality. The training will be more intensive and provided at the doorsteps. The formation of self-help groups will flourish community development, gender empowerment and promote the concept of saving money and build self-confidence and social security in the long term.

2) Cluster approach –

It is important that economic viability must be considered for financing by institutions and sustainability of a project. It is to be ensured that whatever little surplus production is there, it should effectively be channelized into a well-defined market set-up. This will expand and upgrade the backyard activity level, for which cluster approach is essential.

3) Backward and forward linkage-

The backward linkages are requirement of minimum infrastructure, inputs, feed, health services etc. The forward linkages are marketing of eggs, meat, poultry products. Both these have to be provided by a resource or link agency. These units should concentrate on inputs and services including procurement, rather than production.

4) Mother Units and Mobilizing NGO's/SHG's-

Suitable NGO's should be involved for operating the mother units. It is necessary that they form Self Help Groups (SHG's) at the

backyard level, as the SHG can address the problems of their micro financing as well as foster dependence for common cause on other members with common interest. For the success of the program economic viability and deep commitment of the mother units is essential. Even the financial institutions will come forward to assist these highly motivated and confident group.

5) Convergence of Poultry Activities-

Poultry farming is one of the components of the many developmental programs for rural farmers, women, tribal's and other weaker sections of the society. NABARD and NCDC finance the poultry business. The proposal envisages linkages with other developmental agencies and programs through connecting networks between agencies / programs and research institutes, State Agricultural Institutions, ICAR institutions, etc. this would help in the effective implementation of the program and also offer platform for trouble shooting and problem management.

6) Out reach of Services-

It is necessary to work in close lias on with the District Rural Development Agencies (DRDA's) who help in increasing the outreach of activities and help in extension through District /Block Extension teams. Suitable Link Worker Couples (LWC)/ Community Link Workers (CLW) / Village Facilitators (VFs)/ Poultry Link Workers (PLWs), are selected through mass contact programs and trained intensively for skill and service dissemination. This additional tier of workers will increase the outreach and also will develop the necessary rapport within and between the villages through their link and help sort out common problems. Link workers will be from the same villages and preferably more forward farmer couples, who alongwith their own operations will provide inputs and services to other villagers.

13.11 SUMMARY

The domestication of poultry took place several thousand years ago. This may have originally been as a result of people hatching and rearing young birds fro eggs collected from the wild, but later involved keeping the birds permanently in captivity. In recent years poultry farming has developed faster. It is now not merely an allied activity or subsidiary occupation but is practiced as an independent business giving maximum profit. Rural and urban youths are attracted to this business. New techniques of production, modern equipment's and improved variety of birds are used today. Because of new technique and technology more sustainability is seen in this business.

13.12 QUESTIONS FOR SELF- STUDY:

1) What is poultry farming? Give its concept and scope.
2) Answer in detail – Artificial Insemination
3) Discuss incubation and incubation management.
4) What are the essentials of poultry farming?
5) Importance of poultry in rural development – discuss.
6) Discuss the holistic approach towards poultry farming
7) Write short notes on:
    a) Breeding Methods
    b) Mating Methods
    c) Factors affecting hatchability
    d) Objectives of egg production
    e) Objectives of broilers

14

POULTRY –II

Unit Structure :

14.0 OBJECTIVES

1) To know the varieties of chicken producing eggs and for meat production.
2) To study the shelter of chickens.
3) To understand the management of poultry business.
4) To study the constituents of chicken food.
5) To know the diseases of poultry birds and their remedies.

14.1 INTRODUCTION

Poultry keeping, in India, has for a long time remained a rural cottage enterprise. The common village hen receives very little attention and care. As a result its productivity also is low. But now poultry is one of the fastest growing segments of the agricultural sector. The poultry sector in India has undergone a total change in structure and its operation. A significant feature of India's poultry industry is its transformation from a mere backyard activity to a major commercial activity in a very short span of four decades.

Sizeable investments in breeding, hatching, rearing, and processing has involved in the transformation. Indian farmers have started to rear hybrid birds ensuring faster growth, good livability, excellent feed conversion and high profits to bird rearers. The growth in the Indian poultry is due to the initiative of private enterprises, minimum government interference, considerable

indigenous poultry genetics capabilities and great support from the veterans, poultry feed, equipment, and the processing industries. India is one of the very few countries in the world that has put into place a sustained Specific Pathogen Free (SPF) egg production project.

A strong platform for poultry in India has been created and is experimenting with new techniques and innovations for processed chicken meat, medicines, feed additives, health products, related equipment's, management of the poultry industry and other technical services.

Using poultry as a tool; small farmers, marginal farmers and landless labor families can be enriched not only in terms of income raising, employment generation, nutritional status, fostering community development, gender empowerment and environment protection.

14.2 DIFFERENT VARIETIES OF CHICKEN BREEDS

Hundreds of chicken breeds exist and are domesticated for thousands of years. The combined factors of geographical isolation and selection for desired characteristics have created regional types of chicken breeds with distinct physical and behavioral traits and are passed on to their offspring. Physical traits like size, plumage color, comb type, skin color, number of toes, amount of feathering, egg color and place of origin are used to distinguish chicken breeds. They are also roughly divided whether will be used for eggs, meat or for ornamental purpose or for dual purpose of eggs and meat.

14.2.1 Breeds of Chicken for Egg Production :

1) Leghorn :

Leghorn chickens are the most popular chicken breeds due to their ability to produce approximately 300 eggs per year. This breed was the most important in commercial egg production. There are approximately 24 recognized varieties of it. The laboratories for embryonic and avian biological research, because of their prolific egg laying capacities, prefer them. The Leghorn originates from Livorno Italy and its cross bred provides a rarely broody, mobile, and efficient scavenging chicken.

Most leghorn chickens have single combs. There are several color varieties that have rose combs. They occur in recognized colors –white, red, black, tailed red, light brown, dark brown, black, blue, buff- Columbian, barred , exchequer and silver.

Leghorns are nervous types and noisy types of chickens around humans and can fly. Due to their nature they do not make good pets and less popular as a homestead breed.

2) Black Minorca :

Minorca is one of the heaviest of the light breeds. It originates from the Mediterranean. This breed was developed from imported Castilian fowl of Spain in England. They are utility fowl and lay large eggs. They were once in the class of widespread large flocks for laying and meat production, like the leghorn breed, which is the smallest of this class. The distinction of the Minorca is its large white ear patch, which makes it recognizable at a distance. They occur in Black, White, and Blue color. Its egg color is white.

3) Rhode Island Red :

Rhode Island breed chickens are very popular for dual-purpose poultry breed and are preferred among the backyard chicken farmers. They are available in two types Rhode Island Red and Rhode Island White. They adapt very well to all forms of free range as well as combined settings. The red variety is capable of producing 200-250 large eggs annually, which are brown in color. However the cock is very aggressive. The Rhode Island has yellow shanks and performs well under most conditions and rarely goes broody. The Rhode Island breed is one of the most famous egg laying chicken breeds. It appears in various shades of red with some black. The White Rhode Island is a very rare breed.

4) Australorp :

Australorp is a breed originated in Australia from the English Orpington in a bid to improve on their utility. They were known as Black Utility Orpingtons. Austrolorp breed is well suited to Australian conditions and is one of the most efficient egg layers as it averages over 300 eggs per hen per year in commercial selling. But the backyard poultry producers should not expect more than 250 eggs a year. The Black Australorp is an ideal bird for free-range production as they have good temperament. They are quiet chickens, easily contained and handled. Autralorps are hardy, dual purpose types of chicken. Originally developed for exceptional egg laying, they also are a good meat bird, with reasonably early maturity and white skin.

Australorps are large and soft feathered. They occur in Black with green shine the original color. The other color chickens developed are blue and splash.

14.2.2 Breeds for Meat Production :

Poultry sector is gaining great importance in India as it meets the growing demand of millions of people. Eggs and poultry meat are less costly, so middle –class people are willing to improve

their nutritional standards. Its importance among the rural population has increased due to the growth of manpower in this sector. Urbanization, industrialization, rapid increase in the middle-income population and changing socio-cultural habits, the demand for processed poultry products is increasing fast in India. The urban population has high purchasing power and consumes more meat and eggs.

The varieties used for meat production are:

1) New Hampshire :

They originate from New Hampshire in the US. Though it is a dual-purpose bird it formed the basis of early broiler industry. Medium heavy in weight, it matures early and dresses a nice, plump carcass as either a broiler or a rooster. The mature birds color is rich chestnut red, of a lighter and more even shade than the Rhode Island Reds. They possess a deep, broad body, grow feathers very rapidly, are prone to go broody and make good mothers. The comb is single and medium to large in size; and in females it often lops over a bit. They are competitive and aggressive. It is a fair producer of large brown eggs but the New Hampshire was developed more for meat production than egg production.

2) White Sussex :

The Sussex breed is also one of he top breeds. They were originated in Sussex in England. They are very distinctive types of chickens having white body with a black tail and black wing tips, neck being white striped over with black. Other colors include Brown, light, red, speckled, silver, white and coronation. The most famous Sussex are light Sussex. There are many varieties and colors of this breed and they are quite adaptable to any type of environment. Because of their unique nature all the farmers prefer them. The Sussex is for dual purposes types. It is good meat bird maturing quickly for a heavy breed and may go broody. Their capacity to lay eggs is 250 large beige eggs per year. The Sussex chicken is an alert, docile breed and adapts to any surrounding, comfortable in both free range and confined spaces. So many farmers, especially the hobbyists love to keep this chicken breed at their homes.

3) Plymouth Rock :

Plymouth Rock is the first in line of the top most chicken breeds. One of the most common of them all is the black and barred ones. Barred Rock chickens originated in the United States and became very popular. Apart from their names barred coloring they also occur in blue, buff, Columbian, Partridge, silver laced, silver penciled and white. They are large birds with excellent table qualities. They are generally docile, but occasionally aggressive.

They adapt well to confinement and are easy to handle. They are cold, hardy, dual-purpose fowl, useful for meat and egg production. Some varieties are developed only for eggs and some are developed only for meat. They tend to go broody and make good mothers. Overall they are good producers of light to medium brown eggs, yielding approximately 200 eggs per year. These birds are of a calm and friendly nature, due to which they are best suited to being kept in any setting.

4) Wyandotte :

The Wyandotte breed originated in the US, but now with the co-operation of the British it is a well rounded dual purposes bird. The Wyandotte is a medium sized bird. It occurs in colors like white, gold laced and silver laced which are common. They also exist in Black, buff and Columbian, partridge and silver penciled color. The Wyandotte is suited to cold conditions, which make them optimal for free range of production. Wyandotte is docile, friendly and make good pets. The hens are broody and take good care of their young ones. They mature early having big breasts. They are also good layers. It is a reasonable egg producer of about 180-200 eggs per year. It is an excellent source of meat. They need regular washing as their thick feathering about the vent area becomes dirty with faeces.

14.3 POULTRY HOUSING

Another important factor for commercial poultry production is making a suitable poultry housing. There are many ways for making a good poultry house for poultry birds. It is not expensive like buying land. Make sure that, the house or cageis sufficient and spacious enough to accommodate the birds and should have necessary space and facilities. The design of the house depends on the breeds selected and type of production.

Following things should be considered while making a poultry house:-

1) The house must be well ventilated, as good ventilation system ensures good health and proper growth of the birds.
2) Sufficient amount of fresh air and light should be there inside the house.
3) The house should be south facing, as it will help the entrance of sufficient amount of clean and fresh air.
4) The distance from one house to another house should be at-least 40 feet if the poultry business is on large-scale commercial production.

5) Keeping the house clean and fresh before bringing the chicks into the farm is very essential.
6) All types of harmful animals and predators should be prevented.
7) The house should be well facilitated so that rain water, cold winds cannot enter in the house.
8) The house should be built in a calm and quiet place.
9) A proper drainage system inside the house will help to clean the house easily.
10) Keep all equipment in proper distance in the house. Keep the house and equipment always clean in a regular basis.

The type of housing used depends on the amount of ground and the capital available to a large extent.

The four systems of poultry housing generally followed are as follows:-

1) Free Range System or Extensive System
2) Semi-Intensive System
3) Folding System
4) Intensive System
   a) Battery System b) Deep Litter System

1) Free Range System :

This is the oldest method used where there is no shortage of land and has been used for centuries by general farmers. This system allows great space to the birds on land where they can find an appreciable amount of food. The food can be in the form of herbage, seeds and insects, provided they get protection from predatory animals and infectious diseases and parasitic infestation. Due to the advantages of intensive methods this system is the perfect system.

2) Semi-Intensive System :

This system is adopted where there is availability of limited free space. It is necessary to allow 20-30 square yards per bird outside run for the birds. Wherever possible, this space should be divided giving a run on either side of the house of 10-15 square yards per bird. It enables the birds to move on the fresh ground.

3) Folding Unit System :

This housing system is an innovation of recent years. In this portable folding unit birds are confined to one small run. So the position has to be changed every day to give the birds fresh ground. The birds find a considerable proportion of food from the herbage, which are healthier and harder. The beneficial effect of scratching and manuring on the land is a side effect for the farmer.

The disadvantage of this system is that the food and water has to be taken to the birds. Eggs are to be brought back. Extra labor is involved in the regular moving of the fold units. The unit made of 25 hens is the most convenient folding unit to handle. A total floor space of 4 square feet per bird to the whole unit has to be kept, that means a floor space of I square foot is to be allowed for each bird in the house, and 3 square feet in the run has to be kept for the birds. A suitable measurement for a folding house to take 25 birds is 5 feet wide and 20 feet long. The part that is nearest to the house is covered in and the remaining 10' open with wire netting on the sides and top.

4) Intensive System :

This system is usually adopted where there is limited land and is expensive. Here the birds are confined to the house entirely without any access to land. This has been made possible by allowing the sunrays to fall directly on the floor of the house so that the windows are removable, or fold or slide down to permit the ultraviolet rays to reach the birds. Battery or cage system and deep litter methods are most common.

a) Battery System- This appliance is the inventor's latest contribution to the commercial poultry business. This system is useful to those having a small quantity of floor space at their disposal. This is the most intensive type of poultry production. Nowadays it is very difficult to spare open lands in big cities for rearing birds. This system will prove worthy for all those people who can keep the birds in minimum space.

In battery system each and every hen is confined to a cage just large enough to permit very limited movement. It only allows her to stand and sit comfortably. Usually the floor space in this system is 14 x 16 inches with a height of 17 inches.

The floor is made of strong galvanized wire and is set at a slope from back to the front so as to see the laid eggs are rolled out of the cage to a receiving gutter. Underneath is placed a tray for droppings. Food and water receptacle both are outside the cage. Many small cages can be assembled together or it may be multi-storied as per the necessity. The whole structure of the cage should be made of metal so that no parasite will be harbored and can be carried out as often as required through disinfection. The batteries of the cage should be set up in well-ventilated and lighted place. It should not be too hot and vermin proof. The food should meet all nutritional needs. As the bird spends its entire time in the shade, it lessens the load of excess body heat. As a result the expenditure of energy from the bird is minimum.

The feeding of birds in the cages has to be carefully monitored, as they are totally dependent on the rearer for maintenance and production. Availability of vitamin A and D, cod liver oil, yeast, dried milk powder is necessary. Also fishmeal or other animal protein, balanced minerals and some form of grit must be available. Performance of each bird should be noted so that culling can be easily carried out. Pullets used more often than birds of over one year, should be placed in the cages at least one month before they are expected to lay eggs. As there will be only pullets in the cage one can never expect fertilized eggs. There will only be vegetative eggs that can be preserved for a longer time, than fertilized eggs at ordinary temperature. They can never be used for hatching purpose.

b) Deep Litter System:

Deep litter system resembles to dry compost. In this system the poultry birds are kept in large pens. The number of birds kept in each pen is 250 birds. The floor is covered with litters like straw, sawdust, or leaves up to the depth of 8-12 inches. We can define deep litter system as the accumulation of the material used for litter with the poultry manure till it reaches a depth of 8-12 inches. The build-up has to be carried out correctly for the desired results, that require very little attention.

Advantages of Deep Litter System:

1) Safety of birds:

The birds and eggs are safe when enclosed in deep litter intensive pen, which has strong wire netting or expanded metal.

Litter as a source of food supply: It is surprising to learn that built-up litter also supplies some of the food requirements of the birds. The birds obtain “Animal Protein Factor” from deep litter system. It is interesting to note that with only a vegetable protein such as groundnut meal included in the feed the birds obtain sufficient of animal protein factor. The level of vitamins such as riboflavin increases up to nearly three-fold. According to the experiments done the combination of riboflavin and animal protein factor is necessary to good hatchability of eggs and early growth of chickens.

2) Disease Control:

Well-managed deep litter kept in dry condition has a sterilizing effect with no wet spots around water. The level of worm infestation is less if the birds kept on good litter condition, but in bare yards and bare floor sheds particularly where there is water spillage the level of infestation is high.

Labor Savings: It is an important feature of deep litter system. Cleaning of poultry pens daily or weekly requires lot of work. If proper care is taken and correct condition observed and well managed litter there is no need to clean a pen for a whole year. The only attention required is the regular stirring and adding of some material.

The valuable fertilizer: This is a valuable economic factor with deep litter. In this system it is said that the birds can produce about 1 ton of deep litter fertilizer. Nitrogen level in fresh manure is about 1%, while on well built-up litter it may be around 3%. The other contents are 2% phosphorous and 2% potash. The value of this manure is about 3 times than that of cattle manure.

3) Hot Weather Safeguard:

This is an important feature of this system in hot climate. The litter maintains the constant temperature. When the temperature is high the birds burrow themselves into the litter to keep themselves cool. Vice versa they can warm themselves when the weather is cool. In other words we can say it is a valuable insulating agent.

14.4 POULTRY MANAGEMENT

Poultry management refers to the practices or production techniques in animal husbandry that help to maximize the efficiency of production. In order to optimize production sound management practices is a must. Scientific poultry management aims at maximizing returns with minimum investment.

Brooder Management:

1) Brooder House: Brooder house should be dirt-free, rain-proof and protected against predators. Brooding pens should have windows covered with wire mesh for adequate ventilation. Dusty environment irritates the respiratory tract of the birds. Dust is one of the vehicles of transmission of diseases. Lots of moisture causes ammonia fumes, which irritate the respiratory tract and eyes of the birds. Comfortable environment is created if there is good ventilation.

2) Sanitation and Hygiene: All movable equipments like feeders, waterers and hovers should be removed from the house, cleaned and disinfected. All litters are to be scraped and removed. The interior as well as exterior of the house should be cleaned under pressure. The house should be disinfected with any commercial disinfectant solution at the recommended concentration. Insecticide should be sprayed to avoid insect threat. Malathion spray/blow lamping or both can be used to control ticks and mites. New litter

should be spread after each cleaning. The insecticides if necessary should be mixed with litter at recommended doses.

3) Litter: Depending on the availability and cost suitable litter material like sawdust and paddy husk should be spread to a length of 5cm. To prevent caking the litter should be stirred at frequent intervals. Only dry litters are to be used. If any wet litter is there it should be removed immediately. This prevents the odor like ammonia.

4) Brooding Temperature: To provide right temperature in the brooder house heating is an essential part. Too high or too low temperature slows down the growth of birds and causes mortality. The temperature of the first week should be 95°F (35°C) and thereafter reduced by 5°F per week till it reaches 70°F (21·10C). The brooder should be shifted at least 24 hours before the chicks arrive. Maximum and minimum thermometer should be hanged in each house to control over the differences in the house temperature. The behavior of the chicks provides better indication, whether they are getting the desired amount of heat. The chicks try to get closer to the source of heat and huddle down under the brooder if the temperature is less than required and when the temperature is too high, the chicks will get away from the source of heat and may even gasp. The chicks will be evenly scattered when the temperature is perfect. Brooders are not necessary after the chicks are about 3 weeks old, in hot weather. Several devices can be used for providing artificial heat. Many a times, electric bulbs of different intensities are used to provide heat in the brooder house. In such cases regulation of temperature is difficult but not impossible. Infrared lamps are also good for brooding. The height and number can be adjusted as per temperature requirement in the brooder house.

5) Brooder Space: Brooder space of 7-10 inch (45-65cm2) is recommended per chick. When small pens are used for brooding, dimension of the house must be taken into consideration. Overcrowding results in starve-outs, culls and increase in disease problems and infestation.

6) Brooder Guard: Hover guards are placed 1.05 to 1.50m from the edge of hover, to prevent the straying of baby chicks from the source of heat. They are not necessary after a week.

7) Floor Space: To start with, floor space of 0.05m2 should be provided per chick. It should be increased by 0.05 m2 after every weeks until the pullets are about 20 weeks of age. For female broiler chicks the floor space should be at least 0.2 m2 and for male chicks it should be 0.15 m2. This should be provided till 8 weeks of

age. Broiler pullets and cockerel chicks should be raised in separate pens as it would be beneficial.

8) Water Space: Plentiful of clean and fresh water is a must. 50 linear cm of water space has to be provided per 100 chicks for the first two weeks. It has to be increased to 152-190 linear cm at 6-8 weeks. The chick fountains are to be left in for several days till the chicks have located the new water source when you change from chick fountain to water trough. To reduce spoilage of water the height of waters should be maintained at 2-5cm above the back height of the chicks. Antibiotics or other stress medications may be added to water if necessary. All waters should be cleaned daily.

14.5 POULTRY FEED MANAGEMENT

Keep fresh feed available at all times, to maintain healthy birds. Limit the amount of feed in feeders to avoid wastes. It is a good practice to fill hanging feeders only three-fourths full, and trough feeders only two –thirds full. For efficient feeding, keep the lip of the feeder pan in a hanging tube-type feeder at the level of the bird's backs.

Non-automatic trough feeders should be filled early in the morning, also during the day whenever feed supplies get low. The left over feed should be removed before refilling the feeders. Contaminated and moldy feed should not be given to the birds. The feeders should be cleaned whenever necessary.

A close check on birds weight and their feed consumption has to be kept. First indication of trouble –a disease outbreak, molt, stress, or poor management is a drop in feed intake. Keep feed as fresh as possible. Store feed in a dry, rat and mouse proof place, where it will not be subject to damage from moisture or losses from rodents. Store the feed in a large galvanized garbage can with a tight lid to prevent damage.

Use a Growing Ration:

Feed supply store can provide you with a growing ration, which contains everything, the chick's need to grow into productive hens. For 6-14 weeks, the ration should contain 17% protein and for 15-20 weeks the ration should contain 14%. Supplementing the mash with grain will reduce the overall cost, near the end of the rearing phase.

Pullets begin to receive grain as soon as they start eating growing mash. Corn, wheat, barley, oats, millet, grain sorghum, or combinations from all of these can be used. Begin with the ratio of grain to mash 10:100. Increase the proportion of grain until the

pullets get equal parts of grain and mash. Use separate hoppers for grain and mash. When the pullets are 18-20 weeks old replace the growing mash with laying mash.

Feeding birds on range:

Range (green feed) cannot provide a complete diet for birds. They need additional nutrients of a growing ration.

Table scraps, garden products and surplus milk can be useful feed supplements to reduce costs. Peelings, stale bread and leafy vegetables such as cabbage, cauliflower, turnips, are useful. Instead of onions, onion flavored eggs can be fed. Fresh or sour milk is a valuable feed. Avoid feeding spoiled or moldy feeds. The chickens should also receive insoluble grit. Grit is available in chick or hen size. Grit should be available free choice, 2 or 3 days per month. Fine gravel is an acceptable substitute for purchased grit.

It is important to note that calcium, bone or seashells do not substitute for grit. Calcium sources dissolve in the birds system, grit does not. Grit is used as “teeth” to grind up hard grains etc., and should be granite or some other hard rock and should be angular, not rounded from stream bottoms. Laying hens need a large amount of calcium for egg shells which can be fulfilled by free choice feeding of oyster shell or calcium grit. Dried egg shells also can be fed back to the hens. Feed loses its quality when stored for longer period.

14.6 POULTRY DISEASE AND THEIR REMEDIES:

There are many common and important diseases that affect the respiratory system (air passages, lungs, air sacs) of poultry. Due to modern systems of management, usually with high poultry densities, these diseases are able to readily spread.

1) Fowl Pox :

There are two forms of fowl pox. The dry form is characterized by, raised wart-like lesions on un-feathered areas (head, legs, vent, etc.). Un-thriftiness and retarded growth are typical symptoms of fowl pox. In laying hens, infection results in a transient decline in egg production. In the wet form there are canker-like lesions in the mouth, pharynx, larynx, and trachea. The wet form may cause respiratory distress by obstructing the upper air passages. Fowl pox is transmitted by direct contact between infected and susceptible birds or by mosquitos. Virus-containing scabs also can serve as a source of infection. The virus, enter the blood stream through the eye, skin wounds, or respiratory tract. Mosquitos are the primary reservoir and spreaders of fowl pox on poultry ranges. No treatment is available. Thus, it is possible to vaccinate to stop an outbreak. The wing-web vaccination method is

used for chickens. Fowl pox outbreaks, can be controlled by spraying to kill mosquitos. However, if fowl pox is endemic in the area, vaccination is recommended.

2) Newcastle Disease :

Newcastle disease affects all birds of all ages. In such species, it causes a mild conjunctivitis. There are three forms of Newcastle disease—mildly pathogenic, moderately pathogenic and highly pathogenic. Newcastle disease is characterized by a sudden onset of clinical signs which include hoarse chirps (in chicks), watery discharge from nostrils, gasping, facial swelling, paralysis, trembling, and twisting of the neck (sign of central nervous system involvement). In adult laying birds, symptoms can include decreased feed and water consumption and a dramatic drop in egg production. The Newcastle virus can be transmitted short distances by the airborne route or contaminated shoes, caretakers, feed deliverers, visitors, tires, dirty equipment, feed sacks, crates, and wild birds. There is no specific treatment for Newcastle disease. Antibiotics can be given for 3–5 days to prevent secondary bacterial infections. For chicks, increasing the brooding temperature 5°F may help reduce losses. Vaccination, good sanitation, and implementation of a comprehensive biosecurity program can prevent this disease.

3) Marek's Disease :

Chickens between 12 to 25 weeks of age are most commonly clinically affected. Marek's disease is a type of avian cancer. Tumors in nerves cause lameness and paralysis. Tumors can occur in the eyes, liver, kidney, spleen, gonads, pancreas, proventriculus, lungs, muscles, and skin can cause blindness, incoordination, un-thriftiness, paleness, weak labored breathing, and enlarged feather follicles. Marek's usually occurs in chickens 12 to 25 weeks of age and Lymphoid Leukosis usually starts at 16 weeks of age. The Marek's virus is transmitted by air within the poultry house and is in the feather dander, chicken house dust, feces and saliva. Infected birds carry the virus in their blood and are a source of infection for susceptible birds. There is no treatment for this disease. But chicks can be vaccinated at the hatchery. While the vaccination prevents tumor formation, it does not prevent infection by the virus.

Infectious Bursal Disease (Gumboro) :

Species affected are chickens. In affected chickens, there is rapid onset of the disease with a sudden drop in feed and water consumption, watery droppings which leads to soiling of feathers around the vent, and vent pecking. The virus is spread by bird-to-bird contact, contact with contaminated people and equipment. The virus is shed in the bird droppings. It can be spread by air on dust particles. Dead birds are also a source of the virus and should be

incinerated. There is no specific treatment. Vitamin-electrolyte therapy is helpful. A vaccine is commercially available.

4) Avian Influenza (Fowl Plague) :

Avian influenza can occur in most species of birds.The mild form produces listlessness, loss of appetite, respiratory distress, diarrhea, transient drops in egg production, and low mortality. The highly pathogenic form produces facial swelling, blue comb and wattles, and dehydration with respiratory distress. Avian influenza is spread by contaminated shoes, clothing, crates, and other equipment's. Insects and rodents may carry the virus from infected to susceptible poultry. There is no effective treatment for avian influenza. Good husbandry, proper nutrition, and broad-spectrum antibiotics may reduce loss from secondary infections if the disease is in its mild form. A vaccination program used in conjunction with a strict quarantine has been used to control mild forms of the disease. Strict quarantine and rapid destruction of all infected flocks remains the only effective method of stopping an avian influenza outbreak.

14.7 SUMMARY:

Poultry keeping, in India, has for a long time remained a rural cottage enterprise. The common village hen receives very little attention and care. As a result its productivity also is low. But now poultry is one of the fastest growing segments of the agricultural sector. The poultry sector in India has undergone a total change in structure and its operation. A significant feature of India's poultry industry is its transformation from a mere backyard activity to a major commercial activity in a very short span of four decades. As this business gives regular income, the standard of living of the people is improved and in turn helps in the rural development.

14.8 QUESTIONS FOR SELF-STUDY:

1) What are the different varieties of chicken breeds?
2) Which breeds of chicken are used for meat production?
3) Discuss the four systems of poultry housing.
4) What are the advantages of deep litter system?
5) What is poultry management?
6) Discuss poultry feed management.
7) Which diseases affect the poultry birds and what are their remedies?
8) Write short notes on:
   a) Poultry Keeping
   b) Poultry housing

15

FISHERIES

Unit Structure :

15.0 OBJECTIVES :

a) To understand the concept and scope of fishing
b) To study the importance and types of fishing
c) To study the preservation of fish
d) To study the fish farming methods

15.1 INTRODUCTION

Fishing in India is a major industry in its coastal states. About 14.5 million people are engaged in fishing. India has 8,118 km of marine coastline. India is a major supplier of fish in the world. Shrimps are one of the major varieties of fish exported. The giant tiger prawn and Indian white prawn are the species chosen for aquaculture. Marine and fresh water catch fishing combined with aquaculture fish farming is a rapidly growing industry in India. Fish as food offers India one of the easiest and fastest way to address malnutrition and food security. Higher productivity, knowledge transfer for sustainable fishing, continued growth in fish production with increase in fish exports have the potential for increasing the living standards of Indian fishermen. Fishing and aquaculture in India has a long history. For centuries India had a traditional

practice of fish culture. Brackish water farming is also an age-old system in India.

15.2 CONCEPT OF FISHING

Fishing is the activity of trying to catch fish. Fishing techniques include hand gathering, spearing, netting, angling and trapping. The term fishing may be applied to catching other aquatic animals.

15.3 SCOPE OF FISHING

Fishing in India employs about 14.5 million people. Rich marine and inland water resources, fisheries and aquaculture of India offer an attractive and promising sector for employment, livelihood and food security. Half of worlds countries receive fish products from India. It has created export driven employment opportunities in India and also greater food security for the world. Indian fisheries and aquaculture has witnessed lot of improvements in craft, tackle and farming methods during the past decades. Central and state governments also have shown interests in the creation of required harvest and post-harvest infrastructure.

15.4 IMPORTANCE OF FISHING

The importance of fishery in a country cannot only be measured by its contribution to the GDP of the country, but also take into consideration that fisheries resources and products are fundamental components of human feeding and employment. Fisheries resources are the self-renewable character. If fishery resources are well managed then their duration is unlimited. The fundamental basis for the conservation and management of fisheries, stem from the biological characteristics. When fish consumed in small quantities, it comprises a nutritionally important part of many people’s diets in developing countries. Fish is a vital source of proteins and micronutrients, and improves the quality of proteinin largely vegetable and starch based diets. It also provides essential amino acids. Fish is also rich in iron, zinc, magnesium, phosphorous, calcium, vitamin A, and vitamin C and iodine. It also contains fatty acids for the development of brain and body.

15.5 BENEFITS OF FISH FARMING

A commercial fish farming business has many advantages. They are as follows:

1) Fish and fish products have huge demand not only in India but also all over the world. It is one of the common favorite food menu in the Indian diet.
2) There is always a high demand for fish in the market and also the prices are high for the fish and its related products.
3) The climate in India is most suitable for fish production and fish farming.
4) Various types of water sources are easily available.
5) Different types of fast growing fish are available and farming those fish species ensures rapid returns in investments.
6) Integrated fish farming is profitable as the feeding cost is less, easily available species, low cost labor and gives maximum production.
7) Fish farming in India is a profitable business with less risk, providing financial freedom and permanent income opportunities. Commercial fish farming can create new employment opportunities with new income.
8) Fish farming can be taken as an allied or subsidiary occupation, if you have all the necessary facilities for starting the business.
9) Minimum capital is required to start this business.

15.6 AQUACULTURE

India laid the foundation for scientific fish farming (carp fish) between 1970 -1980. The production level was very high of 8-10 tons per hectare per year in an incubation centre. This transformed the Indian aquaculture into a modern enterprise. Fishing industry got a major investment boost after the economic liberalization policy of India in 1990's. Indian breeding and culture technologies deal primarily with the different species of carp, catfish, murrels and prawns. The two points taken into consideration while adopting the culture systems are the inputs available in the area and the financial or investment capabilities of the farmer. Extensive aquaculture is carried out in large water bodies and the only input is fish seeds. Semi intensive culture also utilizes natural productivity, elements of fertilization and feeding.

India also practices different culture systems. They are

1) Integrated fish farming with poultry, piggery, horticulture
2) Intensive pond culture with supplementary feeding
3) Composite carp culture
4) Running water fish culture
5) Weed based carp polyculture
6) Pen culture
7) Cage culture

Ponds and tanks are the prime resources for freshwater aquaculture in India. Currently less than 10% of India's natural potential is used. The total brackish-water area under cultivation is only just over 13%of the potential water area available. There is greater opportunity for productive shrimp farming in India. Freshwater aquaculture activity is practiced in the states of West Bengal, Orissa, Andhra Pradesh, Punjab, Haryana, Assam and Tripura. Brackish water aquaculture is mainly practiced in Andhra Pradesh, Tamil Nadu, Orissa and West Bengal.

15.7 FISHING TECHNIQUES

Fishing techniques are methods for catching fish. Fishing techniques include hand-gathering, spear fishing, netting, angling and trapping. Artisanal fishers use traditional methods of fishing, recreational fishers use angling methods and commercial fishers use netting methods.

1) Hand Fishing:

It is possible to fish and gather many sea-foods with minimum equipments by using the hands. Seafood gathered by hands is as easy as picking shellfish or digging crabs or clams. Pearl divers traditionally harvested oysters by free diving.

2) Spear fishing:

Spear fishing is an ancient method of fishing, where in an ordinary spear or specialized instruments like harpoon, trident, arrow or eel spear are used. Some fishing spears use slings or rubber loops to propel the spear.

3) Netting:

Fishing nets are meshes usually prepared by knotting relatively thin threads. Netting is the principal method of commercial fishing. The other methods also used are longlining, trolling, dredging and traps.

4) Artisanal techniques:

a) Chinese fishing nets - They are shore operated lift nets. Huge mechanical contrivances hold out horizontal nets. The nets are dipped into the water and raised again or else they cannot be moved.

b) Lampuki nets - The lampuki fish take shelter under the rafts, seeking shade, and are caught by the fishermen using large mesh nets.

c) Cast nets - Cast nets also called throw nets are round nets with small weights distributed around the edge. The net is thrown by hand in water in such a way that it spreads out and sinks in water. As the net is hauled back fish are caught in that. This has been used since thousands of years.

d) Drift nets - These nets are not anchored. They are mostly used in the coastal waters.

e) Ghosts nets- These are lost nets and are a menace to marine life.

f) Gillnets- Fish which try to pass through by snagging on the gill covers are trapped in these nets and they can neither advance nor retreat.

g) Hand nets- They are also called scoop nets. These nets are small nets held open by a hoop. They are used for scooping up fish near the surface of the water. If the nets have a long handle they are called dip nets. They are called landing nets when used by anglers to help land fish. As hand netting does not harm fish they are used for tag and release or capturing aquarium fish.

h) Tangle nets- They are also known as tooth nets. They have smaller mesh size and are designed to catch the fish by teeth or upper jaw bone instead of gills.

i) Trawl nets- These nets are large nets, conical shaped. They designed to be towed in the sea. The trawl is pulled by one or more boat. These boats are called trawlers and the activity of pulling the trawlers through the water is called trawling.

j) Seine nets- These nets are large fishing nets and can be arranged in different ways. Purse seine, Danish seine and beach seine are the different types of seine nets.

5) Angling: This method of fishing is done, by using a hook. The hook is attached to a line and sometimes weighed down by a sinker to sink in the water. The hook is baited with lures or bait-fish. Angling is the principal method of sport fishing. Commercial fishing also uses this method of fishing and is called longling or commercial trolling.

Angling with a rod: An angler in his float tube plays a hooked pike. Fishing rods give more control of the fishing line.

6) Line Fishing: Fishing with a fishing line is called Line Fishing. Fishing line is a cord made for fishing. Its parameters are its length, material and weight. The factors for chosen for a given fishing

environment include breaking strength, knot strength, UV resistance, castability, limpness, stretch, abrasion resistance and visibility. Modern fishing lines are made from artificial substances. Droplining, Handlining, jiggrpole, jigging, longlining, stabbing, trolling, trotlining are different fishing lines.

7) Bank Fishing: Bank fishing is fishing from riverbank and similar shorelines. Bank fishing's done by using a fishing rod and reel. Nets, spears and traps are also used. Bank fishing has its own requirements like local knowledge, water depth, bank structure, location, time of the day and the type of lures and baits.

8) Casting: It is the act of throwing the fishing line out over the water using a flexible fishing rod.

9) Float tubes: These are small doughnut shaped boats having and underwater seat in the hole. Float tubes are used for fly-fishing. They help the angler to reach in deep water.

10) Fly fishing: They are made with specially fly rods and fly lines. Fly-fishing is a distinct and ancient angling method. Artificial flies are used as lures.

11) Boat fishing: It is done from a boat, from shoreline or riverbank. Compared to fishing from land, fishing from boat is allows more access to different fishing grounds and species of fish.

12) Remote control fishing: This is done by using remote controlled boat. This technique is becoming popular.

13) Trapping: Traps are universal and seem to have been independently invented. Traps are of two types permanent traps or semi-permanent traps.

Destructive Techniques of Fishing:-

Destructive fishing practices cause irreversible damage to the aquatic habitats and ecosystem. If used inappropriately many fishing techniques can be destructive. Some examples of destructive fishing are using explosive, bottom trawling, cyanide fishing, fish toxins, muroami.

15.8 STEPS TO START FISH FARMING:

Fish is the cheapest and most easily digestible animal protein. It was obtained from the natural resources for consumption long back. The scientists were forced to adopt various methods to increase the fish production. Due to over exploitation and pollution the availability of fish declined to a great extent. It has now become

easier to increase the fish production and its availability under controlled or artificial fish farming methods. Fish farming can be done in village ponds, tanks or any other new water body to improve and increase financial status. Employment opportunities are generated for skilled and unskilled youth. The most advanced and popular technology developed in fish farming is the fish culture in which more than one type of compatible fishes are cultured simultaneously. This technology is known as Composite Fish Culture. It enables to get maximum fish production from a pond or a tank with available resources. Any perennial freshwater pond or tank can be used for fish culture. Even seasonal ponds can be used for fish culture for a short duration.

To start fish farming business various steps have to be followed. They are pond preparing, selecting fish breed, feeding the feed, taking care and management and the main step is marketing.

1) Pond Preparing-

The main infrastructure of fish farming is the pond. Without this commercial fish farming cannot be practiced. Fish can be raised in both the ponds seasonal and permanent ponds. Fish farming in seasonal pond will require some fast raising and quick maturing breeds of fish. Pond has to be prepared properly before stocking minnow in the pond. The bottom of the pond should be cleaned accurately and should be fertilized. PH value and soil of the pond should be checked. If the environment of the pond is perfect then the farmer is assured of high production and good profit.

2) Fish Breed-

The overall production and profit depends on the proper selection of fish breeds. Select the fish breeds that would be suitable in the area. Certain factors are to be considered while selecting the fish breed. They are market demand of fish, maintaining facilities, natural facilities, sufficient water, effective utilization and some other factors depending on the area. The suitable fish breeds that can be used for fresh water farming in ponds are Katla, Rui, Grass Carp, Silver Carp, Common carp, Tilapia, Koi, Shrimp, and various types of catfish. Numerous fish breeds can be raised together for the proper utilization of the pond.

3) Feeding-

Most of the farmers in the country depend on natural feeds of pond. But good and high quality fish feed will to maximize the production. In commercial farming fish has to be fed with high quality and nutritious food. Most popular and highly profitable integrated fish farming systems are fish-poultry, fish- dairy, fish- pig, fish- paddy, fish-goat, fish-vegetables.

4) Care and Management-

Good care of fish has to be taken along with the good environment in the pond and high quality feed. The growing fish in the pond requires more attention, care and management. PH level between 7-8 is best suitable for fish farming. Predators are to be prevented from entering the pond and also take essential steps to prevent fish diseases. Prevention is better than cure, so taking the utmost care of pond is the prime concern.

5) Marketing-

You can desire good and high production of fish with proper marketing facilities available. The main facility of commercial fish farming is that the fish can be sold at a proper price. The fishermen in India sell their product in the nearest local market. There is a great demand for Indian fish in the international market also.

Fish farming in India is an ever-increasing business. Growth in population will increase the demand for food. So there are more opportunities for the youth of India to get employment and earn income. It can also solve the problem of poverty, unemployment and hunger in the country.

15.9 FISH PROCESSING

Fish processing is the processes associated with fish and fish products between the time fish are caught or harvested, and the time the final product is delivered to the customer. Fish are highly perishable. A major concern underlying during the processing operations is to prevent fish from deteriorating. The most obvious method for preserving the quality of fish is to keep them alive until they are ready for cooking and eating.

Fish processing is subdivided into fish handling and the manufacture of fish products. Fish handling is the preliminary processing of raw fish. Another natural subdivision is that primary processing is involved in the filleting and freezing of fresh fish to distribute to fresh fish to retail and catering outlets. The secondary processing involves chilled, frozen and canned products for the retail and catering trades. Now-a-days fish processing is undertaken by artisan fisherman, on board fishing or fish processing vessels, and at fish processing plants.

Other methods used to preserve fish and fish products are

a) Controlling the temperature using ice, refrigeration or freezing.
b) Control of water activity by drying, salting, smoking or freeze drying.
c) Physical control of microbial loads by adding acids.
d) Oxygen deprivation like vaccum packing.

Usually more than one of these methods is used. The cold chain should be maintained, when chilled or frozen fish or fish products are transported by road, rail, sea or air. Insulated containers or transport vehicles and adequate refrigeration is required for this transport. Fish processing also deals with proper waste management and with adding value to fish products. There is an increasing demand for ready to eat fish products that do not need much preparation.

15.9.1 Handling the Catch :

When the fish is harvested for commercial purposes, they need some pre-processing so that they can be delivered to the next part of the marketing chain in fresh and undamaged condition.
Common handling processes are:

1) Transferring the catch from the fishing gear to the fishing vessel.
2) Holding the catch before further handling
3) Sorting and grading
4) Bleeding, Gutting and Washing
5) Chilling
6) Storing the chilled fish
7) Unloading the fish when the fishing vessel returns to the port.

The order of operations varies with the fish species and the type of fishing used to catch it, size of the fishing vessel and how long it is at the sea, and the nature of market it is supplying.

15.9.2 Handling Live Fish

The common practice and obvious way of keeping fish fresh is to keep them alive until they are delivered to the buyer or ready to be eaten. The fish are placed in a container in clean water and the dead and damaged fish are removed from that. The water temperature is lowered to starve the fish to reduce their metabolic rate. fish can be kept alive in floating cages, wells and ponds. Holding basins are used in aquaculture, where the water is continuously filtered and its temperature and oxygen level is controlled.

Live fish is transported by methods like simple artisanal method in which fish are placed in plastic bags with an oxygenated atmosphere, to sophisticated methods wherein trucks filter and recycle the water and add oxygen and regulate temperature.

15.9.3Preservation

Preservation techniques are necessary to prevent spoiling of fish and also lengthen shelf life. Spoilage bacteria are the specific bacteria that produce the unpleasant odors and flavors associated with spoiled fish. Preservation techniques work by interrupting one

or more of the needs like right temperature, sufficient water and oxygen and surroundings that are not too acidic.

Classification of preservation techniques is as follows:

a) Control of Temperature :

The metabolic activity in the fish from microbial or autolytic processes can be reduced or stopped on decreasing the temperature. This can be achieved by refrigeration wherein the temperature is dropped to 0 °C, or freezing where the temperature is dropped below -18 °C.

On fishing vessels, the fish are refrigerated mechanically by circulating cold air or by packing the fish in icebox. Chilled seawater is also used to maintain low temperature. Once chilled or frozen, further cooling is necessary to maintain the low temperature for the fishes.

An effective and safe method of preserving the freshness of fish is to chill with ice by distributing ice uniformly around the fish so that the fish remains moist and in an easily stored form suitable for transport. Recent development is pumpable ice technology. Pumpable ice flows like water and it cools fish faster than fresh water solid ice methods and eliminates freeze burns.

b) Control of Water Activity:

The water activity in a fish is defined as the ratio of the water vapor pressure in the fish to the vapor pressure of pure water at the same pressure and temperature. Traditional techniques such as drying, salting and smoking have been used for thousands of years. Recently the techniques added are freeze-drying, water binding humectants, and fully automated equipment with temperature and humidity control. A combination of all this is often used.

In heat or ionizing irradiation method, heat is applied by cooking, blanching or microwave heating, in a manner that pasteurizes or sterilizes fish products. This method kills the bacteria that cause decomposition. Sterilized products are stable at ambient temperatures up to 40 °C, but to ensure they remain sterilized they need packaging in metal censor restorable pouches before the heat treatment.

c) Chemical Control of Microbial Loads :

Bio-preservation is achieved by adding antimicrobials or by increasing the acidity of the fish muscle. Acidity is increased by fermentation, marination or by directly adding acids (acetic, citric, lactic) to fish products. Other preservatives include nitrites, sulphites, sorbates, benzoates and essential oils.

d) Control of the oxygen reduction potential :

Reduction of the oxygen around the fish can increase shelf life and this is done by controlling the atmosphere around the fish, or by vaccum packaging.

Controlled atmospheres have specific combinations of oxygen, carbon dioxide and nitrogen.

e) Combined Techniques :

Two or more techniques are often combined to improve preservation and reduce unwanted side effects. Common combinations are salting and drying, salting and marinating, salting and smoking, drying and smoking, pasteurization and refrigeration and controlled atmosphere and refrigeration.

Waste produced during fish processing operations can be solid or liquid.

Solid wastes include skin, viscera, fish heads and fish bones which can be recycled in fish meal plants or it can be treated as municipal waste.

Liquid wastes include blood water and brine from drained storage tanks, and water discharges from washing and cleaning. This waste should be disposed without damage to the environment and the aquatic ecosystem.

f) Transport :

Fish is traded live, fresh, frozen and is transported in ships, by land and air. Much fish is traded internationally. Live , fresh and frozen fish need special care.

Live fish: Live fish need oxygen, carbon dioxide and ammonia when they are transported. The fish are often starved before they are transported to reduce their metabolism and increase packing intensity.

By Air :

Around five percent of the global fish production is transported by air. It needs special care in preparation, handling and careful scheduling.

By Land or Sea :

Maintenance of the cold chain, for fresh, chilled and frozen products and the optimization of the packing and stowage density are the most challenging aspects of fish transportation by sea. This requires the use of insulated containers of transport vehicles and adequate quantities of coolants or mechanical refrigeration.

g) Final products :

Final products of fish are presented for marketing in one of the following forms.

1) Whole Fish- The fish remains as it is from water with no processing done.
2) Drawn Fish- The fish remains the whole with its internal organs removed.
3) Dressed Fish- Fish is scaled and internal organs removed and ready to cook.
4) Pan Dressed Fish - A dressed fish, which has had its head, tail and fins removed to fit in the pan.
5) Filleted Fish- It is the fleshy side of fish cut lengthwise from the fish along the backbone.
6) Fish Steaks- Large dressed fish with a cross section of the backbone.
7) Fish Sticks- Pieces of fish cut into portion of 3/8 inch thick. They are ready to be cooked coated with batter and breaded.
8) Fish Cakes- They are prepared from flaked fish, potatoes, and seasonings, shaped into cakes, coated with batter, breaded and then packed and frozen and are ready to be cooked.

15.10 GOVERNMENT PROGRAMS

The government of India launched National Fisheries Development Board in 2006 with the activities focused on

1) Intensive aquaculture in ponds and tanks
2) Fisheries Development in Reservoirs.
3) Coastal Agriculture
4) Mari-culture
5) Sea-wood Collection
6) Infrastructure- Fishing Harbors and Landing Centers
7) Fish Dressing Centers and Solar Drying of Fish
8) Domestic Marketing
9) Technology Up-gradation
10) Deep Sea Fishing and Tuna Processing

Its headquarter is in Hyderabad, located in a fish shaped building. The implementation of two programs for inland fisheries – a) Establishing Fish Farmers Development Agencies and b) National Program of Fish Seed Development led to encouragingly increased production of fish in the country.

15.11 SUMMARY

Fishing in India is a major industry in its coastal states. Marine and fresh water catch fishing combined with aquaculture fish farming is a rapidly growing industry in India. Fish as food offers India one of the easiest and fastest way to address malnutrition and food security. Higher productivity, knowledge transfer for sustainable fishing, continued growth in fish production with increase in fish exports have the potential for increasing the living standards of Indian fishermen. Fishing and aquaculture in India has a long history. For centuries India had a traditional practice of fish culture. Brackish water farming is also an age-old system in India.

15.12 QUESTIONS FOR SELF-STUDY:

1) Explain the concept, scope and importance of fishing in India.
2) Discuss Aquaculture.
3) Give the different fishing techniques used for fishing.
4) What are the steps taken to start fishing?
5) What are the different preservation techniques used to prevent spoiling of fish?
6) Write short notes on:
    a) Benefits of fish farming
    b) Fish processing
    c) Handling the catch
    d) Handling live fish
    e) Government programs to support fish farming