Agriculture Studies

Class Eight

NATIONAL CURRICULUM AND TEXTBOOK BOARD, BANGLADESH

Prescribed by the National Curriculum and Textbook Board as a Textbook for class eight from the Academic Year 2013

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NATIONAL CURRICULUM AND TEXTBOOK BOARD, BANGLADESH.

Published by
National Curriculum and Textbook Board
69-70 Motijheel Commercial Area, Dhaka.

First Edition : August, 2012
Revised Edition : September, 2014
Reprint : August, 2018
Reprint : , 2019

Design
National Curriculum and Textbook Board, Bangladesh

For free distribution by the Government of the People's Republic of Bangladesh
Printed by :

Preface

The aim of secondary education is to make the learners fit for entry into higher education by flourishing their latent talents and prospects with a view to building the nation with the spirit of the Language Movement and the Liberation War. To make the learners skilled and competent citizens of the country based on the economic, social, cultural and environmental settings is also an important issue of secondary education.

The textbooks of secondary level have been written and compiled according to the revised curriculum 2012 in accordance with the aims and objectives of National Education Policy-2010.Contents and presentations of the textbooks have been selected according to the moral and humanistic values of Bengali tradition and culture and the spirit of Liberation War 1971 ensuring equal dignity for all irrespective of caste and creed of different religions and sex.

The present government is committed to ensure the successful implementation of Vision 2021. Honorable Prime Minister, Government of the People's Republic of Bangladesh, Sheikh Hasina expressed her firm determination to make the country free from illiteracy and instructed the concerned authority to give free textbooks to every student of the country. National Curriculum and Textbook Board started to distribute textbooks free of cost since 2010 according to her instruction.

Bangladesh is basically an agro based country. Keeping the challenge of 21st century ahead in mind this textbook has been developed to introduce a technique to build up modern agricultural system by capitalizing agricultural science and information technology, the best utilization of limited land, implementation of appropriate technology to bring out the highest amount of crops. It is expected that this textbook will develop students competency on both theoretical and applied agriculture as to help keeping positive role in socio-economic development.

I thank sincerely all for their intellectual labor who were involved in the process of revision, writing, editing, art and design of the textbook.

Prof. Narayan Chandra Saha
Chairman
National Curriculum and Textbook Board, Bangladesh

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Chapter One

Agriculture In Bangladesh and International Perspectives

Agriculture is the backbone of the economy of Bangladesh. Even in the era of industrialization, the livelihood of Bangladesh mainly is dependent on agriculture. However, compared to international agriculture, Bangladesh is underdeveloped in many sectors. Though Bangladesh is an agricultural country and rice with fish is our favourite food, the production of rice in bangladesh is still much lower than other countries like Vietnam, USA, China, Japan etc. Considering international perspectives, the agricultural scientists of Bangladesh are now thinking in competitive manners. Once upon a time 75 percent of world jute was produced in Bangladesh. But due to increasing demand for rice and use of artificial fiber, farmers reduced jute production compared to rice. However, jute is still playing a better role in the growth of national income. Every year Bangladesh earns a remarkable amount of foreign currency by exporting jute and jute-based products.

It is not true that only Bangladeshi products are available in our markets, but products from neighboring countries have also entered in our markets. As a result, a competitive market has been created between Bangladesh and other countries.

In this chapter, the agricultural conditons of Bangladesh and other countries are discussed.

Fig. Agricultural research organization

At the end of this chapter, we will be able to -

- explain the contribution of scientists in agriculture
- make a relationship between modern agricultural production and changes in our lifestyle
- describe the advancement agriculture in Bangladesh compared to some selected countries in the world
- compare the agriculture in Bangladesh with other selected countries

Lesson-1: Contribution of scientists in agriculture

Scientists have laudable contributions to agriculture. After a long term- research and analysis, scientists have been included new findings in agriculture which lead to the modernization of agricultural activities. Teachers of agricultural universities and researchers of agricultural research organizations are agricultural the scientists. Likewise, the farmers are the agricultural scientists too. General people are the pioneer of ancient agriculture. University teachers and researchers are performing advanced research considering climate, environment, soil, water, production technologies etc. As a consequence of their tireless research, new technologies are being added to agriculture.

It is necessary to know about the problems of agriculture in Bangladesh. The main problems are -

1. problems in soil nutrients
2. problems regarding fertilizer management
3. problems as a result of flood and drought
4. problems due to salinity

Scientists are playing a great role to solve the above problems. With a view to solving the nutritional problems, scientists have divided the country into thirty ecological zones. Determination of the soil "types of these zones" is an important contribution of agricultural scientists. Soil types of ecological zones are

considered to recommend the doses of fertilizers for crop production. Similarly, a well-organized fertilizer recommendation has been developed by scientists. Considering the fertilizer dose of previous crops and the fertilizer uptake, pattern of fertilizer doses for the subsequent crops are determined.

Flood, drought, salinity are the major problems of Bangladesh agriculture. Scientists have achieved a significant advancement to solve this problem. For example, the rice research institute has invented two types of paddy in the name of Kiron and Dishari as late varieties to be cultivated after the flood. Recently, scientists have invented two more types of paddy BRRI Dhan 51 and BRRI Dhan 52 for the flood-affected areas. These two types of paddy can remain under water for 10-15 days. This is obviously a significant contribution to agriculture. Drought and salinity are, like flood, two of the major problems to our farmers. For this, the scientists have invented drought tolerant paddy- BRRI 56 and BRRI 57. In addition, BRRI Dhan 45 and BRRI Dhan 47 have been developed to overcome the problem of salinity in coastal areas.

Through their experiences, farmers are also inventing new technologies which are adding new horizon in agriculture. For example, Haripada Kapali, a farmer from the district of Jhenidah, invented a new variety of paddy known as 'Hari Dhaan'. For some plants, plant parts are used as seeds for propagation. Scientists observed an additional advantage of such type of seeds. Propagation with such seeds can produce a seedling identical to its parents. Farmers use vegetative propagation in banana, mango, litchi, orange, rose, etc. Improvement of quality of seed, development of new varieties, seed storage, determining the causes of diseases, improving nutritional values of crops- all these are done by the agricultural scientists. Even from harvesting to marketing, ensuring food security and keeping food healthy, all kinds of technologies are accomplished by agricultural scientists and other scientists by research.

The activities of other branches of science are also involved with agriculture. Not only the scientists of Agronomy, but also the scientists of Soil Science, Genetics and Plant Breeding, Crop Botany, Horticulture, Entomology, Plant Pathology, Farm Power and Machinery, Irrigation and Water Management etc. are contributing in agriculture through their invention and implementation of information and technology. In addition, another group of scientists are working on animal husbandry and animal health.

Furthermore, some scientists are involved in performing research on fish farming, breeding and marketing. Like other countries, we have various research institutes specialized to perform research in those areas. Scientists from those institutes and organizations are playing an important role in different sectors of agriculture.

Work: Students will be divided into several groups and will discuss about the contributions of agricultural scientists. Then they will make a poster followed by a presentation and present it in the class room.

Lesson-2: Lifestyle and culture of Bangladeshi people and modernization of agriculture

Life style- culture and agriculture in Bangladeshi people are tied in the same string. From the ancient time in agriculture was one of the major supports of this country. With the advancement of time, this ancient agriculture has developed by the touch of modernisation. By using modern agriculture and technologies, our agriculture has been carrying gigantic success in agricultural production. In spite of this, once upon a time the agro based-country Bangladesh faced a serious food scarcity and famine. Besides this, the famine during the 2nd world war engulfed Bangladesh. In fear of being plundered by Japanese army, the British government either took away the food grain from Bengal and Asam to the West or destroyed them. As a result, millions of people in East Bengal died from unbearable famine. At that time British Government took an outstanding decision in spite of having difficulties in the World War. They established an Agricultural Institute at Sher-e-Bangla Nagar in Dhaka (now Sher-e-Bangla Agricultural University), a Veterinary College in Comilla and a Faculty of Agriculture in the University of Dhaka which initiated the facility of taking a bachelor degree in the field of Agriculture. In addition, they started a specialized department as 'The Department of Agriculture'. Although it did not improve the famine situation instantly, the modernization of agriculture was initiated. During Pakistan period, an Agricultural University was established in this country. Later, some Agricultural Extension Training Institute (AETI) and Veterinary Training Institutes (VTI) were established to make skill field worker at grassroots level. Almost every district got a government Agriculture farm and a

poultry farm also a dairy farm in some districts as demonstration farms. To perform research on economic crops like jute, sugarcane and tea, specialized research institutes were established in Dhaka, Ishwardi and Srimangal respectively, in parallel agricultural and rice research institutes were established in Gazipur.

As a result of these initiatives instead of accomplishments, the initiation of the modernization of agriculture was started in the early 1960s. This influenced rice cultivation the most. Local Rice varieties with various taste and aroma having a low yield was replaced by high yielding modern varieties developed by IRRI and BRRI. The cultivation of these rice varieties increased the demand for fertilizers and machinary for irrigation and other cultural practices. As a result, cost of production has been increasing gradually. Farmers with less or no capital either converted into field workers or migrated to cities and towns to find new professions. However, poultry and dairy farming have created some opportunities for employment of rural people. Due to the improved transportation and marketing, the poultry farms are increasing more rapidly near urban areas.

Increase in crop production in agriculture, high returns from animal products like egg, milk, meat and leather lead to an increase in income and dissemination of education among rural life.

Since soil or land is the base of agriculture, scientists are doing endless research works on soils. Scientists have discovered a lot of important information about soil types, soil classifications, soil fertility, soil microorganisms and other benefits. Farmers have adopted the technologies regarding nutrition, growth, reproduction, treatments of crop plants, livestock, fishes which results in constant advancement of agriculture towards the production of healthy balanced diets. Today, genetics of plants and animals have brought a great success in agriculture. The productivity of high yielding rice, wheat, maize, barley has been increased many times.

At present, there are four agricultural universities and one veterinary university in Bangladesh. Beside agricultural study, teachers of most of the science and technology universities conduct research. As a result of their research, agriculture extension officer and field workers can make high-yield varieties and technology

available to the farmers. Agricultural production is developing by leaps and bound. We heard about 'hybrid rice'. If it is cultivated following proper methods, it may produce more yield than conventional high yielding varieties.

Scientists imported many kinds of flowers, fruits, vegetables, cattle, fishes, trees etc. from abroad and added to the existing agriculture. Further, they developed environment-friendly new varieties through breeding that make a better progress of agriculture in this country.

This advancement of agricultural production has also improved the lifestyle of rural people. Use of agricultural implements is increasing. The diversity of production, as well as competition, is increasing. At the same time, use of capital is also increasing. Production of fish, poultry and egg is now reached into industrial level. So the demand for education and skill is increasing in rural life.

Work : Students will act and express the changes in the lifestyles by the modernization of agriculture.

Lesson-3: Advancement of agriculture in different countries in the world

Now-a-days, the countries of the world are classified into developed and developing countries. These countries are also classified as industrialized and agro-based countries.

Industrialized countries are also advanced in agriculture. These countries developing their agriculture, turn it into industry. On the other hand, the government and the famers of agriculture dependent country cannot avail of and use agricultural technology, because of the poor economy. In fact, now a days, developing countries are underdeveloped and developed countries are developed in agriculture.

Advancement of agriculture in independent Bangladesh: In the beginning of independence, there was an agricultural university, an agricultural institute, a veterinary training institute and several agricultural extension training institutes. At present, there are four agricultural universities and one veterinary university in Bangladesh. In addition, most of the science and technology

universities possess the Faculty of Agriculture and Animal Husbandry. Now there are specialized laboratories for all agricultural crops. Every year agriculture fairs are organized in both rural and urban areas. Integrated Pest Management (IPM) for making agriculture more environment-friendly and other different activities have been introduced to increase farmer's awareness and skills in better agricultural processes. To minimize the use of chemical fertilizers by preparing green manures and compost applying in the field and vermicomposting related technologies are being transferred to farmers. Huge progress has been made in production and processing of fodder, poultry and fish feeds to meet the food shortage of cattle, poultry and fish. Poultry industry is now a notable agricultural industry in Bangladesh and a large portion of fishes in the market come from cultured fishes. Every year government is encouraging tree plantation program which makes the farmers interested towards agroforestry or social forestry. In agricultural universities, Masters and PhD level education are being extended. Advancement in biotechnology or genetic engineering opened a new opportunity for Bangladesh agriculture. Decoding the genetic map of jute by a Bangladeshi scientist is a remarkable event. Therefore, the modern era has started in Bangladesh agriculture.

Agriculture in India: India is a big country having a diversified geography. Except for some desert areas, most of the hilly areas and plain lands are agriculture-based. The agro ecology of this country is also diversified. As a result, field crops, flowers, fruits, vegetables, meat, milk, egg and many more are produced in India and are available in the markets. The agricultural science and technologies in India are not only useful for India but also for the rest of the world. Bangladesh is one of the remarkable importers of Indian agricultural products.

Agriculture in China: The advantages of socialistic planned production and distribution are playing a supporting role in the development of the agricultural system in China. Although it is a country having the largest population in the world, there is no significant food crisis in China. Chinese scientists have already built the capacity to produce the highest per hectare yield of rice, wheat and maize. China is the leading supplier of newly adopted hybrid rice in our country. So, it is essential to learn Chinese technologies and applying them at the field level.

Agriculture in Vietnam: The farmer communities and agriculture have a great role in the development of Vietnam. Vietnam is the largest rice exporting country in the world. The Vietnamese success in the development of agricultural technologies for the last few years is a matter of wonder. We have many things to learn from them. The facts of agricultural development of Vietnam are not only confined to the country but also disseminated throughout the world.

The component organization of the United Nations who works in this perspective throughout the world is: "Food and Agricultural Organization (FAO)". There are also some specialized crop research institutions like "International Rice Research Institute (IRRI)". They are playing important roles in the development of our agriculture.

Work:

1. Individually each student will write a passage about "Advancement of Bangladesh agriculture" on their notebook and then they will present this in the class.
2. Write how modernization of agricultrue impact lifestyle and present it in your class.

Lesson-4: Comparison of Bangladesh agriculture in the perspective of Asia and the World

Bangladesh, India, China and Vietnam are situated in Asia. Due to geographical reasons, there are some similarities as well as dissimilarities among these countries. Rice is the main agricultural product in these four countries. People of these four countries are habituated to consume rice as a staple food. Among these, China, India and Bangladesh are highly populated countries. The situation of Vietnam is not so extreme.

Bangladesh vs. China

China is more developed in agriculture than Bangladesh. In many sectors, China is more advanced than Bangladesh, specially in agro-based products. China has been able to change genetic characteristics of rice to such an extent that most of the species of their rice are no more dependent on seasons. These varieties are producing 7-fold more yield than previously cultivated conventional varieties. They are also claiming that their future generation rice will yield double than the existing varieties. However, there is a big limitation of these super hybrid rice is that their seeds cannot be stored for future reproduction. Their genetic potential finished in a single generation. For Chinese socio-economic and political condition, these crops may be suitable or riskless. But in Bangladesh, there are some problems. By heritage, farmers in Bangladesh are not dependent on seed traders for rice seeds, because about 85% of the rice seeds are stored and used by the farmers themselves. The seeds of high yielding rice varieties which were developed by Bangladesh Rice Research Institute (BRRI) can be grown by the farmers themselves in their land and can be stored for the next season. So, there is one kind of freedom of rice farmers about rice seeds. However, Bangladesh Agricultural University and Bangladesh Rice Research Institute are trying to develop some varieties of super hybrid rice. It is desired that farmers in Bangladesh will soon get seeds of those varieties. By this time farmers of Bangladesh have experienced cultivating these types of variety because some seed companies were interested to introduce these seeds in Bangladesh and the government approved their activities with a condition that they will produce the seed in this country.

Lesson-5: Bangladesh vs. India

India is our neighbouring country. We have both historical and cultural relationship with this country. This relationship is also true in case of agriculture. Both of the countries are affected with by increasing population growth rate. To solve the problem of food crisis, both of the countries are dependent on the farmers.

However, Agriculture in India is more advanced than in Bangladesh. India is far

more advanced than Bangladesh in producing rice and other cereals, pulses, flowers, fruits, vegetables, oilseeds, cotton, sugarcane as well as poultry, dairy, fisheries and other agricultural commodities. India has got the world's largest dairy cooperative organization which is an ideal example in the world. In spite of having similar history and culture like Bangladesh, India has markedly changed this trend of development by last 60-70 years. One of the major reasons is that the Indian farmers are more organized than Bangladeshi farmers; and another reason is the outstanding advancement in agricultural science and technologies. Indian scientists are not only leading the Indian agriculture but also world agriculture. Indeed, the area of work is also very vast in India.

Being a country of 18 times larger than Bangladesh, agro ecological-diversity in this country is a matter of challenge and prospect as well. India has got different types of ecological regions: from desert to ice-covered area; from low marshy land to hilly uneven area; infertile drought-prone area to fertile floodplain area. While ice cool winter is prevailing in a part of the country, another part is experiencing summer or spring. As a result, throughout India, almost all types of crops grow all the year round.

However, the per unit yield of most of the crops in Bangladesh and India is almost similar. But in some regions of India like Punjab, Haryana, Kerala the per unit yield of crops is very high.

Almost all of the agricultural commodities except jute, leather, Hilsha fish are exported from India to Bangladesh.

Bangladesh vs. Vietnam

The top-most similarity between Bangladeshi and Vietnamese agriculture is the production of rice. But the progress of Vietnamese farmers is more rapid than that of Bangladeshi farmers. Twenty five years ago, the progress of agriculture was less advanced and even weaker. Now, in "every sectors" of agriculture Vietnam has crossed Bangladesh. The main reason is that the Vietnamese farmer communities are very much organized. The agricultural cooperative societies in Vietnam are very powerful and creative. All the farmers of Vietnam are related to some cooperative society. The agricultural cooperatives are so strong that they provide 50% of the annual cost of government and they also provide economic

support to local agricultural research and extension organizations. They also play a vital role in decision making and planning of those organizations. Meanwhile, Bangladesh has adopted some field technologies from Vietnam.

Work: Students will be divided into several groups and discuss about the comparison between the advancement of Bangladesh agriculture with other asian countries. Then they will write them in a poster as chart and present in the classroom.

Lesson-6: Overcoming the seasonal dependency of crops

Photoperiodism of crop plants is the main reason for overcoming seasonal dependency. If a season-dependent crop can be made as season independent through photoperiodism, it can be grown in any season.

Utilities:

1. Off-seasonal fruit and vegetable has a great demand in the market. Crop produced at this time are sold at a higher price. Both farmers and retailers may earn extra money.
2. Marketing of early harvested crops can be a product of high value.
3. Seasonal unemployment is reduced and people may become busy round the year.
4. For the same reason rural manpower can be utilized, around the year.
5. 'Monga' or such other situation can be avoided.
6. It may increase the diversity of agricultural commodities.
7. Overcoming the nutritional problems may be easier.
8. It may reduce the dependency of importing and may save foreign currency.
9. It may ensure the foreign buyers to get commodities all the time which can result in the expansion of foreign trade.
10. Agricultural research may be free from seasonal dependency.

Different strategies to overcome the seasonal dependency of crops

1. Creating artificial environment for crop production: In this technique, any crop may be grown without changing its biological qualities. In this case, desired crops are grown in green house instead of an open field or garden.

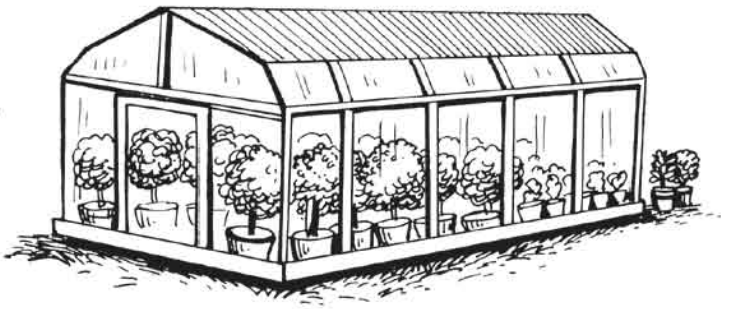


Fig. Green House

Here day-length, light, temperature, atmospheric humidity and other necessary factors are being controlled artificially in a closed chamber which is suitable for crops. On the other hand, required balanced nutrients are supplied to plants. The prerequisite for implementation of this technique is to gather the detail information about the environment and nutrients of crops. Secondly, the proper methods of creating a suitable environment and applying proper nutrients should be established and maintained. Thirdly, uninterrupted electricity supply should be ensured. Though any crop can be grown in this way, the production cost is very high. This technique can be applied to grow some special crops. Logically, large scale production of any crop is not possible in this technique. It is not logical to use this technique except for high value and special crops. In this technique, production of crops in large scale is difficult.

Since this technique is fully controlled, the crops produced by this technique are completely healthy and disease free.

In our country, this technique has been used to produce Capsicum, strawberry and tomato and found that this technique may be used to grow special crops with profit. At present, the market price of these crops is very high.

2. Manipulating the genetics of crops: The permanent and less expensive way to overcome seasonal dependency is manipulating the genetics of crops. In this

case, gene sequence may be changed; the genes which are responsible for seasonal dependency may be deleted or changed so that they remain inactive. Besides hybridization and recurrent selection, this goal can be achieved by many other modern ways. These kinds of crops are called GM crops or genetically modified crops and these technologies are generally termed as Genetic Engineering or Biotechnology.

3. An experienced farmer may also identify and develop seasonal dependent lines of crops by observation, selection and experimentation. If these lines can adapt to field condition, may be certified as variety/cultivar. These early or late varieties which are invented by farmers become very popular the at the field level. As a result, popular agricultural products remain available in the market for a long time. Due to the low production cost of these crops, farmers can earn more profit. This is the oldest method of developing crop varieties by the humans.

Work: Explain, how logical it is to grow crops in green-house in Bangladesh.

Exercise

Multiple choice questions

1. **What amount of percentage of the required rice seed of the country is preserved and used by the farmers themselves?**

   a. 65% b. 75%

   c. 85% d. 95%

2. **If seasonal dependency of crops can be overcome-**

   i. Unemployment problems will be solved

   ii. Price of products will be ensured

   iii. Various kinds of crop will be available

which one of the below is the correctone?

a. i and ii
b. i and iii
c. ii and iii
d. i, ii and iii

Read the passage below and answer to the question number 3 and 4

Mrs. Rawshan Ara, in her home garden, planted some seedlings of fruit-tree raised by cutting from the branches and she also sown some vegetable seeds and obtained a good yield. But in the next year, she could not get a good yield from the vegetables which were raised from the seeds produced by her.

3. What types of characteristics of Mrs. Rawshan Ara's fruit trees will have?

a. Like the mother plant
b. Like the father plant
c. Better than the mother plant
d. Like both the mother and the father plant

4. What is the reason behind getting a low yield of vegetables in the following season?

a. Collection of seeds from her own garden
b. Cultivation of vegetables in the same land
c. Having same characteristics of the mother plant
d. Having characteristics of both the mother and the father plants

Creative questions

1. Farmers of the village of Enayetpur cultivate crops on the basis of seasons. In most of the time, their high land remains vacant. As a result, at that time farmers become unemployed. In addition to the lack of crops in their land, unemployment makes them crazy and they went to Agricultural Officer for seeking suggestion. Agricultural Officer motivated them in cultivating crops varieties which are free from seasonal dependency. Cultivating seasonal dependency free varieties of rice and vegetables, the farmers of Enayetpur village are now self-sufficient.

a. What are GM crop?
b. Cultivation of super hybrid rice exploits the freedom of the farmers - explain.
c. Explain which steps were taken by the farmers of Enayetpur village to get success in crop production.
d. Analyse how the farmers of Enayetpur village became self-sufficient by the advice of Agricultural Officer.

2. Mr. Rafiq, a farmer, was watching a television report on the agriculture of Vietnam. That report was showing the agricultural technologies used in farming, methods of cultivation, and farmers' activities followed in Vietnam. In that report, the reporter also mentioned that the less developed countries like Bangladesh cannot use the modern agricultural technologies which make them underdeveloped. Mr. Rafiq got an idea about Vietnamese agriculture through that television program and he organized the farmers of his area.

a. What is agriculture?
b. General people are the pioneer of ancient agriculture - explain.
c. Explain how Mr. Rafiq organized the farmers of his area.
d. Evaluate the comment of the reporter about Bangladesh agriculture.

Chapter 2

Agricultural Technology

Invention of technology is a continuous process. Once a technology is released, it continues for few years. Then other better technologies are invented. People adopt those new technologies as per their necessities. For example, fertilizer is a chemical technology. Since long period, farmers have been using improved fertilizers for a long since supply nutrients to the plants. In the same way, old technologies are always replaced by new technologies.

Fig. Application of urea supergranules in rice field

At the end of this chapter we will be able to -

- explain the use of various technologies in agriculture
- explain the diversification of field crops
- explain the cropping pattern

Use of various technologies in agriculture

Lesson-1: Application of urea supergranules in rice cultivation

Concept of urea super granules: Many kinds of fertilizer are used in rice cultivation. Among these, urea is the most vital nutrient that contains nitrogen. For the convenience of application granular urea fertilizer is converted into urea super granules by machine.

Fig. Urea super granules

Fig. Granular urea

Necessities of urea super granules

Necessity of using urea super granules arises from the limitation of using conventional granular urea fertilizer. Therefore, at the beginning of this lesson the advantage and disadvantages of using conventional granular urea are discussed. Later, the advantages and disadvantages of urea super granules will be outlined.

Advantages of using granular Urea fertilizer :

- It is very easy to use.
- Its using does not affect plant roots.
- It is available in the market.
- It takes less time and labour to use it.

Disadvantages of using granular urea fertilizer:

- Granular urea needed split application in several times.
- There is possibility of leaching loss due to quick decomposition.
- This fertilizer can be washed out from the soil with rain or irrigation water.
- Utilization of this fertilizer takes more time and effort.

Advantages of using urea super granules:

- Urea supergranules need to be used only once in a season.
- Using urea supergranules save 20-30% of the nitrogen.
- Urea supergranules supply nitrogen to the plant slowly.
- Using urea supergranules can produce 15-20% higher yield.

Disadvantages of using urea super granules :

- Plant roots may be affected.
- Desired granule size is not always available.
- It cannot be applied in dry soil.
- It takes more time and labour to apply it.

Methods of application of urea supergranules in rice field

Five to seven days before the application of urea supergranules, rice seedling is to be transplanted maintaining 20×20 cm distance between line to line and plant to plant as well. Within 5-7 days of transplanting of seedlings, before being the soil hard, urea supergranules should be applied. Application of urea supergranules becomes easier when it is applied in the field containing 2-3 cm of water.

There are different weights of a single urea super granule, viz. 0.9 g, 1.8 g and 2.7 g. The doses of using them in the paddy field are determined according to the weight of granule. For example, if the weight is 0.9 g, then 3 granules is to be placed in the middle of 4 hills for boro rice. For aman and aus 2 granules are to be applied. For the granule of 1.8 g, 2 granules should be used in case of boro and 1 granule for aus and aman. On the other hand, if the granule size is 2.7 g, then 1 granule is enough for boro rice.

Urea super granules are easier to apply in the crops planted in lines. At first the urea super granules are placed into 10 cm deep in the middle of first 4 hills of first line. After wards, the granules are placed in similar depth, maintaining 4 hills gap in between. When first line is completed, the second line to be started which is followed by second, third, fourth line and so on. In this way the entire field is to be covered.

Fig. Application of urea supergranules

Works: Students will divide themselves into groups and explain what type of fertilizer is more beneficial for paddy cultivation.

New words: Granular urea, urea supergranules

Lesson 2: Cattle fattening

In our country, livestock production has not been reached as high as rice and vegetable production. It should be bear in mind that without developing livestock sector, required amount of protein cannot be supplied to the people. Daily requirement for meat Per person is about 120g. But from a statistics it was observed that a Bangladeshi person takes only 24g meat per day. From this statistics it is clear that we have a deficiency of animal protein. Therefore, Supply of beef should be increased. In order to solve this problem cattle fattening programme has been developed. With the help of this technology cattle can be fattened within short period of time. These fattened cattle are marketed at high price and these are highly profitable.

System of cattle fattening:

Key points of cattle fattening system:

1) **Cattle selection and purchase:** Male cattle are suitable for fattening. For this purpose, it is better to purchase a bull calf of 1.5 to 2 years of age.

2) **Housing:** House should be built on a land of 1.5m x 2 m dimension for each cattle.

3) **Treatment of diseases:** For treatment of any disease it is better to take suggestions from doctor. Vaccination against contagious diseases is must.

4) **Feed supply:** Feed that contains high amount of protein, carbohydrate, fat, minerals and vitamins should be supplied to the cattle.

Feed (ration) formulation for fattening: Cattle fattening means ensuring cattle health by supplying proper amount of feed and there by supplying protein to the human being. Animal gets nutrition from feed and grown up physically. Cattle should be provided with such type of feed that contains more amount of protein, carbohydrate, fat, minerals and vitamins that of common feeds. Straw, maize or wheat crust, molasses,oil cake etc are rich source of protein, carbohydrate and fat. Green grass, bone meal etc contain minerals and vitamins.

Urea and molasses mixed feed are helpful in fattening of cattle. These items can be supplied in two ways 1) By mixing with straw and 2) By mixing with concentrate.

Preparation of cattle feed by mixing urea with straw:

- Firstly, a large type of basket is to be taken and plastered with mud then dried.
- 20 liters of water is to be taken in a bucket
- 1 kg of urea is to be mixed with that water
- Out of 20kg straw, small amount should be kept in the dol and Urea solution is to be sprayed over it. Pressing is done while adding straw.

- Dol is to be fulfilled with straw in this way.
- Dol is to be covered with polythene after filling it and kept it tied.
- After 10-12 days straw will be taken out of the dol and will be kept
- outside for sun drying.
- After sun drying straw will be suitable for feeding.
- A regular cattle is to be fed 3kg urea mixed straw.
- Each day, 300-400 gm of molasses should be mixed with straw.

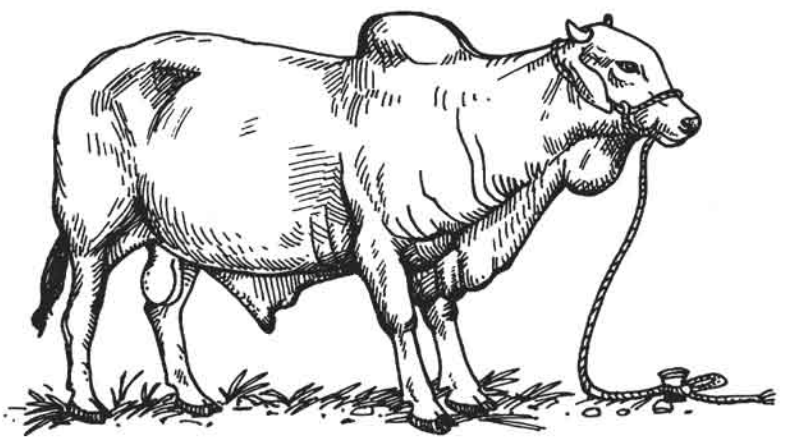


Fig. Fattened Cow

Work: Find out what quantity of urea, molasses and straw is needed to fatten 10 cattle?

New Word: Livestock, cattle fattening, dol, molasses

Lesson-3: Crop diseases and their control

Concept of crop diseases

Do we know crop plants suffer from diseases? We may think that human and animals face diseases, do plants face the same? Yes, they do. Every living organism faces life, disease and death. It is surrounded by virus, bacteria and many other micro organisms which disseminate diseases. Human, animals as well as plants are infested by micro organisms and become disease-infected. Like human and animal, plants can also be cured from disease by proper treatment. Due to lack of proper treatment crops may die.

If we go to crop field we can observe these symptoms of diseases:

- We can observe vari-ous spots on the stem or leaves. Sometimes mosaic-like mixed spots of yellow-green are also observed.
- Some of the cases rotten roots are observed or sometimes wilted of rotten seedlings are observed in the seed bed.
- These are symptoms of disease.

Fig. Crop disease

By observing these symptoms farmers become aware and take control measures. Now we may have curiosity to know what crop disease is. If there are some abnormalities observed in plant structures such as insufficient growth, weak and thin appearance of flowers or fruit dropping, it means the plant is suffering from disease. Diseases are reflected by different symptoms. Various crops are affected by various diseases and their symptoms are also different. Symptoms of various disease-infected crops are mentioned below–

1. **Spot:** Various spots appear in the leaves, stems or other parts of plant. These spots may be black, light brown, dark brown or water soaked in appearance. These spots appear due to different diseases. For example, brown spot on rice is a symptom of fungal disease.

Fig. Mosaic disease of okra

2. **Blight:** In this case leaves are blighted or burned. Example, Leaf blight of rice and potato.

3. **Mosaic:** When dark or light-yellowish mixed staining appears on the leaves of crop plants, it is called mosaic. Mosaic diseases occur in okra and mung bean. It is a symptom of viral disease.

Fig. Wilting disease of egg plant

4. **Wilting:** Sometimes stems and roots of crops are affected by diseases and they are hung downward. This condition is called wilting. Example: wilting disease of egg plant.

5. **Leaf curling:** Leaves of crop plants are curled due to virus infection. This symptom is observed in the crops like papaya, tomato.

Prevention: Preventive measures should be taken before the crop is affected by diseases because if a crop is affected by a disease, it is difficult to control. Therefore, before disease infestation the following technologies should be used.

1. **Use of pathogen free seeds:** Many diseases are disseminated through seeds. Therefore, farmers should collect disease free seeds and planting seeds by treatment.

2. **Seed treatment:** Some seeds themselves contain pathogens. To disinfect the pathogens from seeds seed treatment is a good technology. In this case, fungicides are used.

3. **Practicing clean cultivation:** In some of the cases, crop may be infected by diseases when the field is weed infested. So, field should be free of weed before cultivation.

4. **Burning or burying of disease infected crop plants:** When a plant is affected by disease it may be spread into another plant. To prevent this kind of spreading, infected crop plants may be pulled out followed by burning. Otherwise, they should be buried deep to the soil.

Work: Students will collect samples of diseased plants mentioned in the lesson. Then they will discuss and present them in the classroom.

New words: Leaf spot, blight, mosaic, seed treatment, fungus, virus

Lesson-4: Management of dead animals, birds and fish :

1. Disposal of dead animals 2. Disposal of dead birds 3. disposal of dead fish

Disposal of dead animals: Dead animals should not be kept here and there. Environment is polluted by diseased animals. Germs of dead animals spread

in the air and also infect healthy animals. Dead animals should be disposed as early as possible. Dead animals should be disposed far from dwelling space and farm. Dead animals should be buried in high land and at least 1.2 meters deep in soil. DDT or lime powder should be spread over the pit.

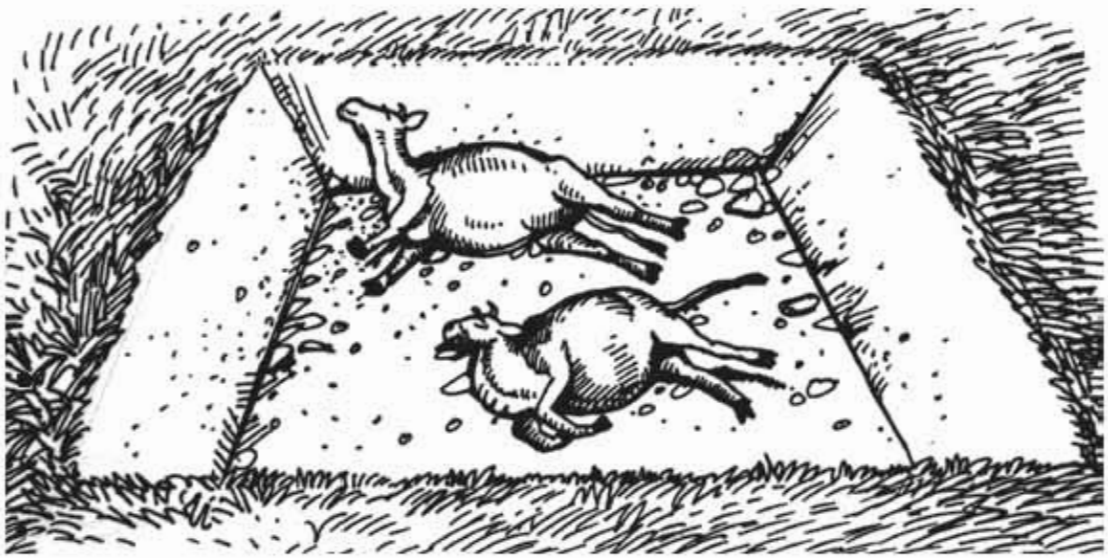


Figure. Dead animal thrown in pit

Disposal of dead birds: Dead birds should be disposed far from homestead and farms. Dead birds should not be left here and there. Rather, they should be burled. Otherwise, germs may spread out from the dead birds and affect the healthy and living ones. If birds die epidemically in the farm they should be buried into big holes. DDT should be spread over the dead birds and top soil of the holes.

Disposal of dead fish: Sometimes treatment can not cure the diseased fish. Fish start to die massively. This dead fish become rotten and pollute the environment. In this situation, following measures should be taken–

- Dead fish should be collected through nets.
- A 3-feet deep hole should be dug in a place far from the pond so that rain water cannot run down from that place to the pond.
- Width of the hole will depend on the quantity of dead fish.
- Dead fish should be thrown into the hole and bleaching powder should be spread over them.
- Finally, the hole should be filled with soil.

Lesson-5: Diversification of field crops

Have we observed what types of crop the farmers cultivate in their field? We can visit and observe which field is rice-based, which field is sugarcane-based, which field is cotton-based and which field is jute-based.

Crop diversification is a suitable crop rotation for a cropping system. It is a cropping system in which different types of crops are grown rather than dependency on a single crop or technology.

The objectives of crop diversification are-

1. To increase the crop production of a specific cropping pattern and to increase the farmers income and the standard of their lifestyles.
2. To coordinate the farming activities and to minimize the adverse effects on agro ecology.
3. To include new crop varieties and technologies in the existing cropping patterns.
4. To save seeds and reduce the production cost.
5. To identify technology usage related problems of the farmers and solve them.

1. **Cropping pattern:** The land of Bangladesh is suitable for various kinds of crop. But every farmer follows cropping pattern for crop cultivation. Growing of crop in sequences throughout the year followed in a particular area is called cropping pattern of that area. Soil quality, availability of water, cultivation methods, crop varieties, risk, and income are considered in a cropping pattern. Including legume crops in a cropping pattern may reduce the demand of fertilizers and soil fertility is also increased.

2. **Mixed and relay cropping:** Mixed and relay cropping indicates the production of multiple crops together in a same land which growing level is different, take food from the different layers of soil and they grow in different seasons case insect infestation, disease infection and environmental risks are less.

3. **Zero tillage method:** Zero tillage means cultivation without tillage. Zero tillage is practiced in flood-affected rice-based cropping pattern. For

example, after flood, when water goes out then lentil, maize, garlic etc may be sown or planted using residual soil moisture which produces good yield. It also takes 3-4 weeks less time than normal.

4. **Relay cropping:** Farmers cultivate legume crops in between flowering and one week before harvesting of main crop to get some advantages. It is called relay cropping. The objective of this cropping is to minimize the unavailability of irrigation, labor and time. Our farmers generally follow relay cropping in rice field. In relay cropping soil structure is improved and fertility is increased.

5. **Proper utilization of resources:** The main objectives of crop diversification is (i) more production and (ii) more income. Land, fertilizer, seed, irrigation water, agricultural machineries, time are the resources of farmers. Farmer's income depends on the proper utilization of resources. For example, farmers can earn more profit from mixed or relay cropping. On the other hand, zero tillage may save both time and money. If legume crops is included in a cropping pattern it can reduce the demand of fertilizers.

Fig. Potato with sugarcane

Fig. Wheat, mung bean and maize

Work: Describe how mixed cropping is done in crops diversification in your locality.

New words: Crop diversification, cropping pattern, mixed cropping, relay cropping, proper utilization of resources.

Lesson-6: Use of diversification of field crops

The climate of Bangladesh is humid and hot. Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall. Round the year different crops are cultivated here in three different seasons. They are Rabi, Kharif-1 and Kharif-2. Every year farmers include those crops in their cropping pattern. Crops are selected on the basis of duration of production, soil fertility, irrigation facility etc. Three different examples on the utilization of diversification of field crops are given below.

1. **Cultivation of pointed gourd as relay crop with potato:** This is a remarkable example of crop diversification. Farmers try to make changes in their farming practices to improve their economic condition. In this effort, cultivation of pointed gourd as relay cropping with potato is very popular. In case of relay cropping, when first crop reaches its maturity then second crop is planted. Farmers cultivate early varieties of potato in the month of October-November. Potatoes are planted in rows maintaining spacing of 55 cm. In the month of December, pointed gourd is planted in each third row of potato. Potato harvesting is completed during January-February. Then pointed gourd continues to grow and fruiting started from March and can be harvested up to November.

   In this technique, there is no requirement of additional fertilizers for pointed gourd. In this case extra income is possible from the same piece of land.

2. **Cultivation of bitter gourd as relay crop with potato:** There is also a scope to cultivate bitter gourd with potato. The farmers of northern part of Bangladesh newly started to cultivate bitter gourd with potato to boost up the production. Farmers plant potato seeds in rows during early in the season i.e. October-November. Furrows are created between two rows.

After planting of potato bitter gourd seedlings are grown in poly bags. In the month of January, seedlings of bitter gourd are planted in between two rows of potato. Harvesting of potato is completed in mid February. After harvesting of potato the bitter gourd plants grow quickly and fruiting is started from the month of March. Bitter gourd can be harvested up to September-December. This is another technique of crop diversification.

3. **Cultivation of potato and red amaranth as mixed cropping:** Red amaranth is a short duration and quick growing crop. Cultivating red amaranth with potato is a good practice of mix cropping. It is already mentioned that potato is planted in rows. When potato plant becomes 5-6 cm tall then soils between the rows are loosen. Then seeds of red amaranth are sown in loose soil. Potato and red amaranth grow simultaneously. Red amaranth is quick growing. So, it can be harvested several times. Red amaranth can be harvested up to the month of December. Potato still grows even after complete harvest of red amaranth. Potato is harvested in mid February.

Besides the above methods of crop diversification, as a relay crop-

1. Tomato is cultivated with sugarcane
2. Mustard is cultivated with sugarcane
3. Lentil is cultivated with sugarcane

As a mix crop-

1. Mustard is cultivated with lentil
2. Sesame is cultivated with aus rice
3. Aus rice is cultivated in banana orchard

Fig. Potato as a relay crop with banana

Work: Observe a mixed crop field and submit a report on this.

New words: Mixed cropping, relay cropping

Lesson-7: Concept of crop rotation

Crop rotation is an improved agricultural technology. Crop rotation facilitates good condition of soil, good crops and high yield. Pest and disease infestation become lower and efficiency of fertilizer becomes higher. Use of crop rotation as a technology is practiced throughout the world.

Crop rotation is the practice of growing a series of dissimilar/different types of crop in the same area in sequential way maintaining the soil under good condition. In other words, crop rotation is the practice of growing different types of crop in the same land instead of growing a particular crop again and again. For example, shallow rooted crops should be cultivated followed by deep rooted crops. As a result, pest and disease infestation become low.

To practice crop rotation, farmers divide their land into three or four plots. In the first year, different crops are grown according to Rabi, Kharif-1 and Kharif-2 season. In the second year, crop of second plot is replaced by crop what was grown in the first plot, similarly, third plot is replaced by second plot, and the same sequence end by replacing first plot with fourth plot of first year. After second year, third years also follow similar sequence of changes. In the fourth year, crop rotation is finished and every crop is cultivated once in every plot.

For crop rotation, crop should be selected considering the following factors:

1. Not to cultivate same crop continuously;
2. Not to cultivate crops having same root system;
3. Selecting different crops which have various demand of nutrients;
4. Including pulse crops in the pattern;
5. Cultivating green manures like dhaincha (Sesbania);
6. Cultivating fodder crops for cattle;
7. Cultivating both food crops and cash crops;

Advantages of crop rotation

There are many advantages of crop rotation which are mentioned below -

- Crop rotation can preserve the fertility of soil;
- A balance of nutrients is maintained;
- Weed infestation becomes lower;
- Pest and disease infestation become lower;
- Water loss is minimized;
- Yield is increased;
- Cattle feeds become available.

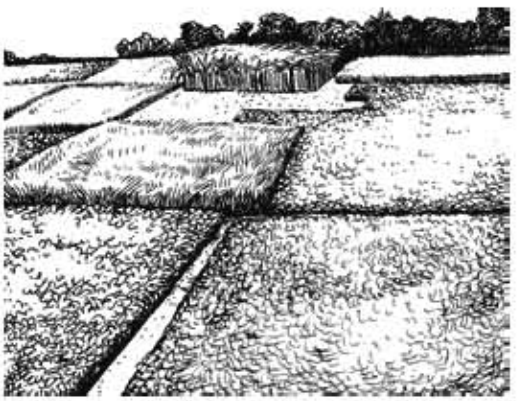


Fig. Crop rotation with different crops

Consequence of crop rotation:

a) Crop rotation ensures the high grade of crop diversification technology;
b) Infestation of pest, diseases and weeds become lower;
c) Since various kinds of crop are cultivated, soil fertility is maintained;
d) Plant can uptake balanced nutrition;
e) Nitrogen is added to soil;
f) Decreases the use of pesticide.

Work: Farmers of your village practice crop rotation. Discuss with them about crop rotation then write down why and how the farmers of your village followed crop rotation.

New words: Crop rotation, deep rooted, shallow rooted

Lesson-8: Utilization of crop rotation

In previous lesson, we have got a concept about crop rotation. We have also come to know that the farmers are practicing crop rotation with or without having knowledge about it. They do not have any scientific explanation. But they have the knowledge that if the same crop is cultivated for many years in the same land, the yield is reduced. Soil fertility is reduced. Many problems like the infestation of pest and diseases occur. Farmers have divided their cultivated crops into Rabi, Kharif-1 and Kharif-2. So, at first farmers decide which crops will be cultivated based on every season. Secondly they decide which crops will be grown in which plot. As per rules of crop rotation land should be divided into several plots. The size of the plots should also be the same. However, the land of Bangladeshi farmers are divided into many small pieces due to several reasons. As a result, the plot size may not be similar. Farmers select the land and crops on the basis of their experience.

Almost all the areas of Panchagarh and Thakurgaon and north western part of Dinajpur are included in Agroecological Zone-1. It consists of high, medium high and medium low land. Farmers of this region cultivate wheat, jute, broadcasting aus, foxtail millet, transplanted aman, potato, vegetables, mung bean, sugarcane, chilli, boro rice, maize etc. farmers cultivate both irrigated and rainfed crops. If we observe what kind of crop rotation is practiced by the farmers of this region, we can get a practical idea about crop rotation.

Suppose, a farmer from Thakurgaon has 4 plots of land, he planned a crop rotation for four years. He decided to cultivate wheat, jute/aus rice, transplanted aman, potato, vegetables, dhaincha, sugarcane, chilli, sesame on the basis of Rabi, Kharif-1 and Kharif-2 season. To cultivate those crops farmer can practice

the following crop rotation mentioned in the chart below. In the crop rotation schedule, we can observe that the cropping pattern which was followed in the first year is the same in case of the closing year or fourth year.

Year	Plot-1	Plot-2	Plot-3	Plot-4
First year	Rabi: Boro Kharif -1: Jute/broadcasting aus Kharif -2: Fallow	Rabi: Mustard/wheat Kharif -1: Mung bean Kharif -2: Transplanted aman	Rabi: Potato Kharif -1: Black gram Kharif -2: Transplanted aman	Rabi: Cauliflower, cabbage, radish, tomato Kharif -1: Maize Kharif -2: Egg plant
Second year	Rabi: Cauliflower, cabbage, radish, tomato Kharif -1: Maize Kharif -2: Egg plant	Rabi: Potato Kharif -1: Black gram Kharif -2: Transpla nted aman	Rabi: Mustard/wheat Kharif -1: Mung bean Kharif -2: Transplanted aman	Rabi: Boro Kharif -1: Jute/broadcasting aus Kharif -2: Fallow
Third year	Rabi: Potato Kharif -1: Black gram Kharif -2: Transplanted aman	Rabi: Cauliflower, cabbage, radish, tomato K harif -1: Maize Kharif -2: Egg plant	Rabi: Boro Kharif -1: Jute/broadcasting aus Kharif -2: Fallow	Rabi: Mustard/wheat Kharif -1: Mung bean Kharif -2: Transplanted aman
Fourth year	Rabi: Wheat Kharif -1: Jute, Broadcasting aman Kharif -2: Transplanted aman	Rabi: Mustard/wheat Kharif -1: Mung bean Kharif -2: Fallow	Rabi: Potato Kharif -1: Black gram Kharif -2: Transplanted aman	Rabi: Cauliflower, cabbage, radish, tomato Kharif -1: Maize Kharif -2: Egg plant

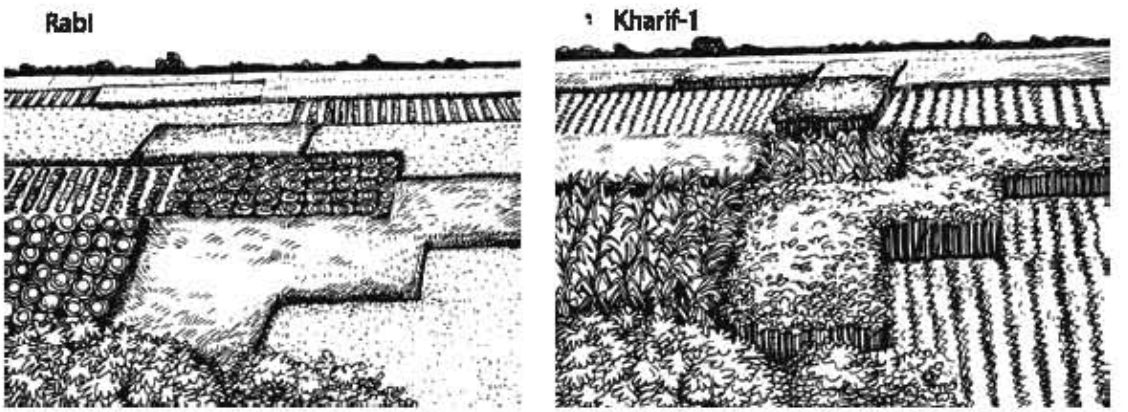


Fig. Crop rotation practice

Work: Your father asked you for a crop rotation schedule. Based on the above chart make a crop rotation schedule for your father so that he can start it from the upcoming Rabi season and present the schedule in the class.

New words: Rabi, Kharif-1, Kharif-2

Exercise

Multiple Choice Questions

1. Which one is used in disposal of dead animals?

a. DDT b. Formalin

c. Clorine d. Phosphorus

2. Ways of urea and molasses feeding in cattle-

i. Mixed with straw

ii. Mixed with concentrate

iii. Mixed with water

Which one of the following is correct?

a. i and ii b. i and iii

c. ii and iii d. i, ii and iii

Read the following paragraph and give the answer of question no. 3 and 4

There is a 3m x 4m size of high and fallow space in front of Rina Begum's yard. She made a cattle shed in this space and took necessary steps for cattle fattening by taking microcredit from bank.

3. How many animals can be kept in the shed built in Rina Begum's yard?

a. 1 b. 2

c. 3 d. 4

4. How will Rina Begum's family be benefitted from the farm?

a. Meet up the requirement of protein

b. Meet up the requirement of carbohydrate

c. Increase the number of cattle

d. Increase supply of milk

Creative questions

1. Monir cultivated rice in one acre of his land in three consequent years and found that the production decreased gradually in every year. He discussed the matter with agriculture officer. The officer suggested him to adopt crop rotation.

a) What is crop rotation?

b) What are the advantages of cultivating sesbanil (dhoincho) in crop rotation?

c) How will Monir do crop rotation in his field? Explain.

d) If Monir follows the suggestion of the agriculture officer, how much benefited will he be. Analyse.

2.

Fig.: Cultivation process-1.

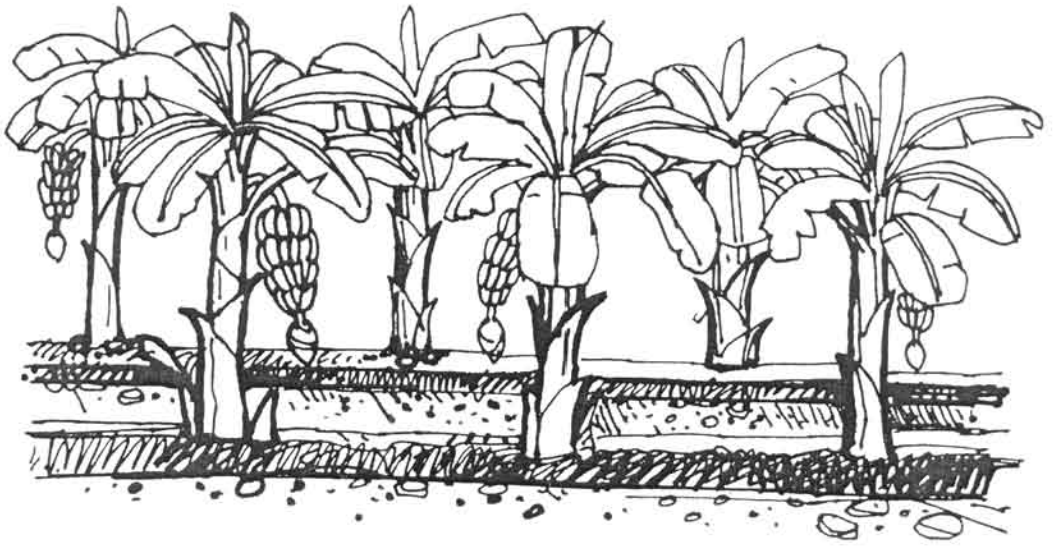


Fig. : Cultivation process-2

a. What is relay crop?

b. How can relay cropping minimize the unavailability of time?

c. In which method of cultivation of the fiqures the cost of production is low? Explain.

d. Which cultivation process of the figures has influenced on agro ecology? Analyse.

Chapter Three

Agricultural Materials

We have discussed many kinds of agricultural materials in the previous class. In this chapter various subjects such as how proper tilth soil can be prepared for sowing seeds, how an ideal seed bed can be prepared and protected; and how judicious fertilizers can be applied in the land will be discussed. Many crop seeds will not be germinated if the soils in the seed bed may not be prepared properly. The seedlings will not be healthy if the seed bed may not be prepared suitably and protected appropriately although soils are in spite of having fertile soil. Another matter is that the farmer does not follow the appropriate rules to fertilize the land. As a result the farmers face economic loss due to excess fertilizer application. So, the discussion of these subjects in this chapter is appropriate.

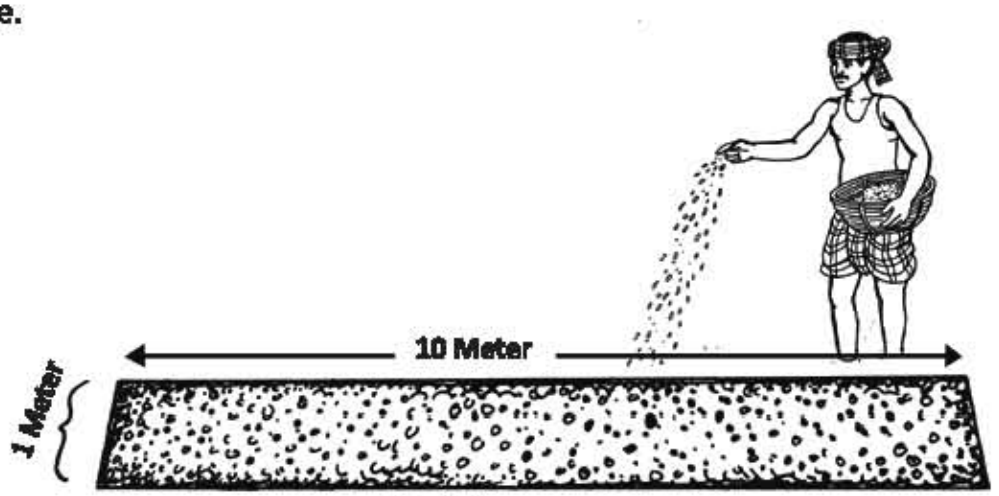


Fig: Wet seed bed

After discussion of this chapter, we can-

- describe the preparing procedure of suitable soils in the seed bed for sowing seed.
- explain making techniques of an ideal seed bed.
- explain protection of an ideal seed bed.

- describe the necessity of judicious fertilizer application in the field.
- describe the necessity of judicious irrigation application in the field.
- establish relationship between higher yield and selection and protection of good seed.

Lesson 1: Preparation of suitable soil in the nursery for seed sowing

We know that seedlings are produced after sowing seeds in the seed bed of nursery. Good seedling is not produced if the soils in the seed bed of nursery can not be prepared efficiently.

The materials needed for preparation of soils in the seed bed are: land, stick, measuring tap, spade, organic and inorganic fertilizers etc. Two types of seed beds are prepared in our country. These are- (a) Dry seed bed and (b) Wet seed bed.

Direct seed sowing could be done in the dry seed bed. In case of wet seed bed, soak the soils in the seed bed with water to prepare a clay mould and level it. Then seed would be sown there.

The rules of soil preparation in the seed bed are as follow :

1. 30 cm wide and 15 cm deep channel will be prepared around the seed bed.
2. Raise the soils of seed bed at 20-25 cm height.
3. Plough the soils of seed bed about 15-20 cm deep.
4. leave the seed bed open for 2-4 days for sun burn to destroy insect and pest.
5. Then pick out grasses, roots and stubbles from the seed bed.
6. Mix some loam soils if the soils of the seed bed are clay; but mix organic matter, loam or clay loam soils in the seed bed if the soils are sandy.

7. So that the soil doesn't get washed away by rain water or strong wind, pored bricks or any other materials may be used around the seed bed.
8. Smash the big clods in the seed bed and plain the upper soil layer.
9. Mix up TSP, MOP and dry cowdung or organic matter with the soils of the seed bed at 10-12 days before seed sowing.
10. Apply fertilizer based on the size of nursery.
11. Insects or pathogens may live in the soils of the nursery. So, put some debris on the seed bed and fire it which may reduce pest infestation.
12. For soil fumigation, use the chemicals like gamaxin, or formaldehyde.

Soils for filling in the polybags: This soil should be prepared following the rules above. Then the soil should be sieved to make it free from clods. After wards polythene bags of definite size should be filled by those soil.

Practical work: The teacher will ask the students to form some groups and ask them to prepare soil for seed sowing on the assigned place of the school premises. The students will then write the procedure of soil preparation for seed sowing in their practical note book by groups and present in the class-room. The teacher will stay with the students to do the work for all time and give direction to complete the task.

Lesson 2: Preparation of an ideal seed bed

The size of seed bed can be different. Now we will learn about an ideal seed bed. The size of this type of seed bed and fertilizer application, soil preparation and protection measures are taken accurately. The teacher will show a model picture of an ideal seed bed in the classroom and ask the students to draw it. Then the teacher will tell the rule making an ideal seed bed.

(A) Seed bed for rice: Seeds in the seed bed are sown to produce seedlings and take care of them until transplant in the main field. So, the selected land is prepared by ploughing and laddering for the preparation of ideal seed bed. Generally, two types of seed bed are prepared: wet seed bed and dry seed bed. The wet seed bed is prepared by the wet clay soils and dry seed bed is prepared by the high land containing sandy-loam soils. The area devoid of tree shades and does not submerge with flood water is selected for seed bed.

Structure of an ideal seed bed: (Rice Crop)

1. The size of every seed bed will be 9.5 m x 1.5 m and earmark it with the help of stick.
2. Keep 50 cm area in between two seed beds and 25 cm area for canal around the seed bed.
3. Raise the seed bed up to 7-10 cm with the soil in between two seed beds and surrounding soil.
4. For per squ. meter of seed bed, mix two kg cow dung or compost with the soils.

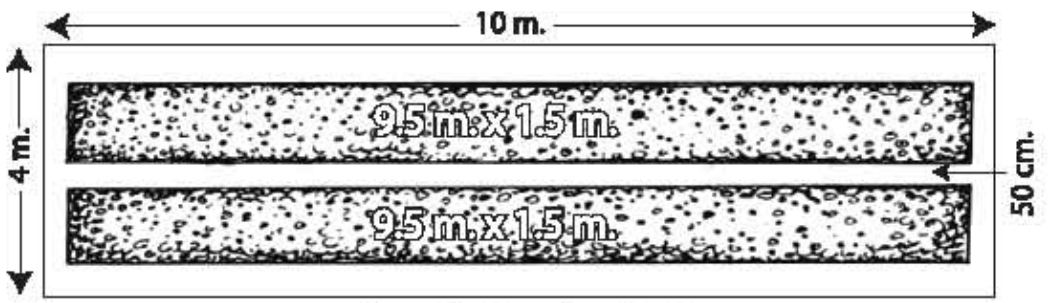


Fig. An ideal paddy seed bed

(B) Seed bed for horticultural crops: Seeds, seedlings or stumps of horticultural plants are sown or transplanted in the nursery to get it ready to be transplanted in the main field. As a result, the normal growths of the seedling are to be assured and more seedlings are produced with careful nursing from the small area.

Structure of an ideal seed bed (Horticultural crops):

(1) Select well-drained and well aerated high, fertile land for the preparation of nursery bed. (2) The size of every seed bed will be 3 m x 1 m and earmark it with the help of stick. (3) Spaded the soils in the nursery to prepare seed bed. 4) Mix 25 kg cowdung or compost with the soils in each seed bed. (5) Prepare a canal measuring 50 cm in between two seed beds. (6) Divide the soils in between two beds and raise the seed bed using this soil up to 10 cm. (7) Then mix 15 gm Urea, 100 gm TSP and 100 gm MOP fertilizer with the soils of each 3 sq. m bed. (8) Apply 150 gm lime in each bed if soils are more acidic. (9) Sow seeds on the bed after removing the stick, rope etc.

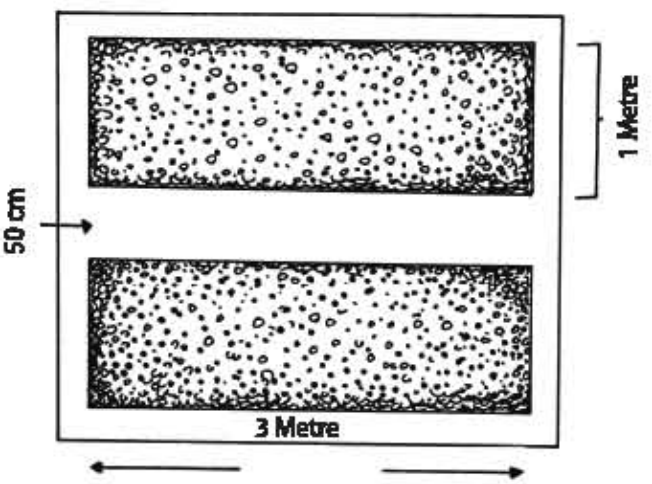


Fig. Ideal horticultural seed bed

(10) vegetable seeds are to be sown as per the following chart :

The rate of seed sowing in a 3 sq.m seed bed	
Name of the vegetables	**Rate of seed sown (gm)**
Cabbage, cauliflower and broccoli	10-12
Kholrabi (Olkopi)	15-20
Turnip	12-14
Tomato	8-10
Brinjal	10-12
Pepper	18-24
Lettuce	8-12
Onion	18-24

Lesson 3: Management of seed bed

The seedlings germinate from seeds in the seed bed So, managing of seed bed should be done carefully. The management systems of seed bed are highlighted below:

(1) Keep the upper soil of seed bed plain; (2) Maintain the seed bed free from weed; (3) Protection measures should be taken if insect and disease attack in the seed bed; (4) Maintain irrigation facilities to keep water in the canal in between two beds; (5) Apply urea 280 gm/ for a decimal area if the seedlings are seemed to be yellowish (6) Do not use raw cow dung in the seed bed; (7) Make fence around the seed bed to protect the seedlings from domestic animals like goat, ram and cow etc; (8) Give shade over seedlings during scorch sunlight to prevent drying of soil.

Work: The teacher will give following questions to the students for group work as the part of lesson evaluation and get it presented by group leaders after group work.

(1) Which type of soil is the best for seed bed?

(2) What points should be given more preferences during site selection of seed bed?

(3) How will you measure the area of land for seedling production?

(4) Why is fence necessary for the seed bed?

(5) What is the most important task for the establishment of seed bed?

Lesson 4: Fertilizer application in the crop field

We have learnt about fertilizers earlier. Now we will discuss about advantages and disadvantages of following the rules of fertilizer application.

There is no alternative of fertilizer for crop production. Because, fertilizer is the food for plant. Usage of chemical fertilizer in the crops in this country has been started in the fifties, and that time farmers became surprise when they were asked to use fertilizer in the crop. The activities of agricultural offices help to lessen this nervousness of the farmer. But unfortunately, it is observed today, the farmers without following the rules of fertilizer application, apply fertilizer in the crop field injudiciously. Now it is important to apply judicious fertilizer in the crop field after soil test to keep healthy growth of crop, in order to increase flower-fruit production and soil fertility.

If fertilizer is used without soil test-

(1) Decrease of crop production and increase cost of production, and (2) loss of soil fertility and environment.

On the other hand, because of judicious fertilizer application-

(1) the soil gets nutrified (2) becomes fertile.

Task to be done before fertilizer application in the soil

In the previous lesson, we learnt about the use of fertilizer. Now let us know about the activities of pre-fertilizer application. The following points should be kept in mind during cultivation of crops in any time of the year–

1. It is necessary to learn about soil properties after soil test. It should be examined wich nutrients and what amount are available in the soil.
2. It is to be learnt which crop will be cultivated in the tested soil.
3. It is necessary to find out the fertilizer demand as crop-wise from the chart of Upazilla Agriculture Office.
4. It is utmost necessary to learn which crop has previously been cultivated in that land sand which fertilizers have been applied previoulsy.

Work: The teacher will give task to the students for the advantages and disadvantages of judicious fertilizer application. The teacher will collect and evaluate the report.

Lesson 5: Efficient methods of fertilizer application

There is no alternative to use of chemical fertilizers to get higher production from limited area of Bangladesh. Now the question is, how we can get maximum yield reducing the use of chemical fertilizers.

The functions of applied fertilizers depend on the application time and methods. It is significant for the nitrogenous fertilizers. Because this fertilizer is easily soluble in water resulting 70% washed out from the soil to go out of the crop

root zone and can pollute the environment. Such as-

1. The existence of urea fertilizer in the soil is transitory and nothing of this fertilizer remains in the soil after cropping season. So, split application of urea is necessary for the demand of crops growth stages.
2. Next to green manuring crop (12-25 ton dhaincha/ha), the rate of nitrogenous fertilizer can be reduced at 15-20 kg/ha for the rice crop.
3. Next to pulse crops (if the plant debris are mixed with the soil), the rate of nitrogenous fertilizer can be reduced at 8-10 kg/ha.
4. The yield of rice is being constant if urea is applied using LCC (Leaf Color Chart), the yield of rice remains good. Then there is an analysis that in this way, urea usage can be reduced by 25% in case of transplanted Amon and 23% in case of Boro rice.
5. Twenty five per cent (25%) urea will be surplus if it is used as the form of Guti urea.

Application of fertilizer in judicious way

We discussed the way of lessening of the fertilizer usage previously. Now let us know the rule of judicious use of fertilizer–

1. Chemical fertilizer must not be used on the seed, near the stem of the tree or on the wet leaves.
2. Apply urea fertilizer on the wet land of rice. In case the land is dry, hoe and sicle is to be used to mix the fertilizer with the land.
3. Organic matter, TSP and MOP fertilizers must be applied before seed sowing or seedling transplantation.
4. If Urea and MOP fertilizers are applied in the sandy soil, the efficiency of the soil will be increased.
5. It is necessary to start split application of fertilizers at the time of first tiller emergence, a little earlier of the appearance of inflorescence of rice, emergence of adventitious root of wheat, height of corn up to the knee and one week before coming out of female flower.
6. Apply three 'guti's of urea in case of Bora rice and two 'guti's in case of Amon, when each 'guti's weight 0.9 gm.

in 7.50-10.00 cm or 3-4 inch soil depth middle of two rows and in between four seedlings of rice. Apply guti urea in the soil in the absence of water on the upper layer.

7. At the time of final ploughing, apply total amount of potash, sulfur and zinc add altogether.

Work: The teacher will arrange a debate competition for the students. The topic of the debate is : 'Only judcious use of chemical fertilizer can ensure better yield.'

Lesson 6 : The judicious application of irrigation in the field

Artificial application of water to fulfill the demand of water during crop production is called irrigation. Rain is the principal source of irrigation water. The rain water comes and remains in the rivers, ponds, haors-baors etc. The part of this water enters into the under ground. On the basis of source, irrigation water is two types: (a) Surface ground water; like rivers, ponds, haors-baors water and (b) Under-ground water. The under ground water is lifted using different irrigation technologies like deep tube well, shallow tube well, power pump etc and used for irrigation purpose. The irrigation water then distributed in the crop lands through kacha or pacca irrigation channel. 52% of agricultural land of this country has been used for irrigation Out of this, 14.35 lakh hectares of land is under surface irrigation and 33.73 lakh hectares of land is under ground water irrigation. A survey report of International Water Management Institute (IWMI) predicted that the irrigation efficiency in our country is only 30-35%. The remaining 65-70% of irrigation water is lost somehow.

Every year much money is spent for purchasing and maintaining irrigation pump and for constructing the irrigation channel, and for the electricity, diesel and petrol to run the pump. 28-30% production cost of Boro, is used for irrigation purpose. It is shocking for the environment that the water layer is going down due to excessive use of under-ground water. So, it is necessary to increase the efficiency of irrigation water by decreasing abuse of valuable water resources.

Availability of water from the soil according to crop demand is the precondition of good yield. During shortage of water in the crop field, it is necessary to supply irrigation water according to crop demand. It is a barrier to use unnecessary water for improved production. Nacessity and scarcity of water, both are hermful for crop developmant. The demand of water also depends on growth stages of crops. However, all irrigation methods are not suitable for our socio-economic conditions. For the use of judicious application of irrigation water, the following point should be taken into consideration:

(A) The type of irrigation channel: Water is transported through irrigation channels. Much of water is abused through kacha irrigation channel. Moreover, additional water is misused if the khaca irrigation channel is not made properly. However, misused of water can be reduced if the irrigation channels are constructed a little high from plain land, then compact soil at both sides and as well as floor of the channel.

(B) Irrigation method: There are many irrigation methods available depending on types of crops, topography of land and properties of soil. Some of the efficient irrigation methods are described below:

1. Check Basin Method : In flood irrigation method, there is no way to control of spreading water. As a result, much of the water is misused. To solve this problem it is necessary to use check basin method. In this method the crop field is divided into several portions based on slope and is given irrigation by checking water.

2. Ring Basin Method: In the fruit garden irrigation water can be supplied through this method which reduces misuse of water. In this method ring or circular channel is prepared around each fruit tree which is connected to the main irrigation channel.

3. Channel Method: In this method many channels are constructed in the crop field based on the area of land and connected with the main irrigation channel. This system is competent for line sowing crops. As it is easy to control water in this method, water wastage becomes less.

4. Sprinkling Irrigation Method: The method by which irrigation is given in the form of rain is called sprinkling irrigation method. In this system water is supplied with the help of pipes and is sprinkled in all directions with the help of a nozzle. The primary cost of this method is high. This method is used in tea garden.

5. Drip Irrigation Method: The method, by which water is supplied to the plant root system, is called drip irrigation method. It is the most judicious irrigation method. It is useful in such areas where the irrigation water is limited.

Work: Student will divide themselves into few groups and discuss about the bad effect of excess irrigation. After completion of discussion they will present it in the class room.

(C) Amount of irrigation water: The plant uptakes water from root zone. With the growth of the plant, the root increases along side and reaches deeper into the earth. So it is essential to saturate the root zone by irrigation. In many crops, 80-90% portion of the root remains within the first 1-1.5 feet of the earth surface. For this reason irrigation water is given at upper 1-1.5 feet soil layer.

(D) Time of irrigation: It is necessary to give irrigation timely for the sake of efficient use of water. The following two points should be taken into consideration for timely irrigation:

1. Moisture availability of soil : Irrigation is given after determining moisture of the soil. There are so many methods of determining of soil moisture. One of the easier methods is hand feeling method. Dug a hole in the land where irrigation is needed. The depth of the hole will be two-third of root depth. Prepare a mud-ball using the collected soils from the floor of hole. If the soil is dry and sandy, it will come out between fingers or after preparation of the ball if the mud-ball breaks down with small pieces then irrigation is imm diately necessary. On the other hand if the mud-ball is produced and does not break or crack after strike it on the ground then irrigation is to be done at 1-2 days later. If the collected soil is soaked and wet mud-ball is produced, moist the hand and does not break after hit the ground, give irrigation 3-4 days after testing the soil. Also, if the wet soil comes out between fingers of hand, soak the hand but water does not come out, then irrigation is not obligatory. Test the soil at 7 days interval.

2. Growth stages of crop: It is not necessary to give equivalent irrigation at all physiological growth stages of crop. The sensible stage of crop is that when the growth of crops affected due to lacking of water. Again, the stages of crop when the yield of crop is drastically reduced owing to shortage of water are called critical stage.

Work: The students will discuss with the help of the teacher about judicious application of irrigation in the crop field and prepare a poster paper.

The sensible stage and the critical stage of some major crops are shown below by chart :

Name of crops	Sensible stages to irrigation	Critical stages to irrigation
Rice	Stages at primary tillaring, panicle initiation, flowering, milk stages	Primary flowering, flowering
Wheat	Tap root initiation, last stages of tillaring, flowering	Flowering, milk stage
Mustard	Vegetative growth and flowering	Flowering
Gram	Pre-flowering stage and seed formation	Pre-flowering stage
Potato	Seedling germination, formation of stolon, preliminary bulb formation	Seedling germination, preliminary bulb formation

During shortage of moisture in the crop field at sensible and critical stages of crops, irrigation must be given. No need of excess water if irrigation is given in the above mentioned way.

Rice is the main food of Bangladesh. Rice is cultivated in about 75% of the total land of this country is used for rice cultivation. The highest amount of rice is produced in Boro season. In this season the maximum irrigation is needed due to lack of rain. It is necessary to keep 10-15 cm stagnant water for traditional irrigation method. For this reason, about 3000- 5000 liter of water is needed for the production of one kg of rice. This is an adequate amount than the actual requirement. Today, alternate wetting and drying method is popularized as judicious irrigation technology for rice cultivation. No stagnant water is needed on the crop field in this method. The irrigation time is controlled by setting up an observation tube in the field. Irrigation, fuel and labour cost are minimized by using this method. This

method decreases irrigation water by 30-37%, decreases diesel cost by 29% and increases rice production by 12 %. Overall it is an environmentally friendly technology.

Work: The students will write on 'the bad effect of excess irrigation in crop field and present in the classroom.'

New words: Upper ground water, below ground water, irrigation efficiency, check basin method, sprinkler irrigation method, drip irrigation method, root zone of crop, sensible and critical stages of irrigation.

Lesson 7: Selection of good seeds

Seeds are fundamental agricultural materials. Regeneration of plants is happen by seeds. According to botany, "the Mature and Fertilized Ovule is called seed". We know regeneration is possible by using other parts of plants. In agronomy they are termed as 'seed'. The agriculturist called them agricultural seed and the mature and fertilized ovule is called "True seed" or "Sexual seed". The characteristics of one generation stream to next generation by seed. In the vegetative propagation, the individuality of mother plant can transfer to next plant. On the other hand, a resultant mixture of the characteristics of father and mother is observed in sexual seeds. Here the problem is the characteristics of mother plant may not go to offspring if it is not self-fertilized. By applying this method, through hybridization of two different types of same crop, a third type can be generated. The third type may bear some good characteristics of the parents. This method of genetic improvement of crop is called hybridization.

The farmer wants to get benefitted by using high yielding variety of the best quality for cultivation. The Agricultural Research Institutes work on the development of seed. Seed Certification Agency gives final recommendation of seed and Bangladesh Agricultural Development Corporation (BADC) distribute seed to the farmer with the help of listed dealers.

The improvement of some seeds or varieties may be achieved by using the method of selection and multiplication. This method of variety improvement is called selection breeding. The main technique here is observation and assortment. Observation and assortment carry out during many generations after hybridization.

Many matters should be taken into consideration before seed selection in farmer's field. Such as-

- Which varieties are suitable for farmer's agricultural environment?
- Which one of these varieties gives yield in short time?
- Which one of these varieties can give the highest yield with minimum cost?
- Which variety is comparatively resistant to disease-pest?
- Which variety is easier to manage in the field?

Although an important quality of HYV (high yielding variety) is higher production, but it is not ascertain to give higher production of a variety if it is not a "quality seed." The qualities of good seeds are :

1. Seeds without mixture of other seeds.
2. Minimum 80% germination capacity.
3. The highest vigor of seedling.
4. Cleanliness of seed.
5. Healthy seed (free from impurity and diseases).

A seed poses above qualities can be determined by easy, quickest and faithful test. The so called "HYV" seed may not give higher yield if lacking of this qualities. So selection of HYV good seed is the pre-requisite for higher production.

Seed germination and seedling vigor test

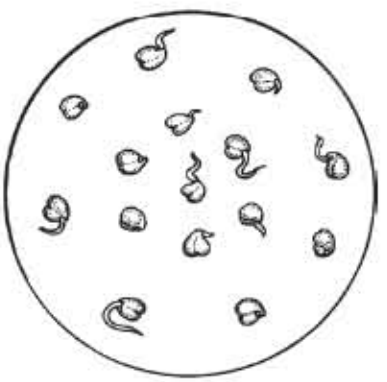


Fig. : Blotter test

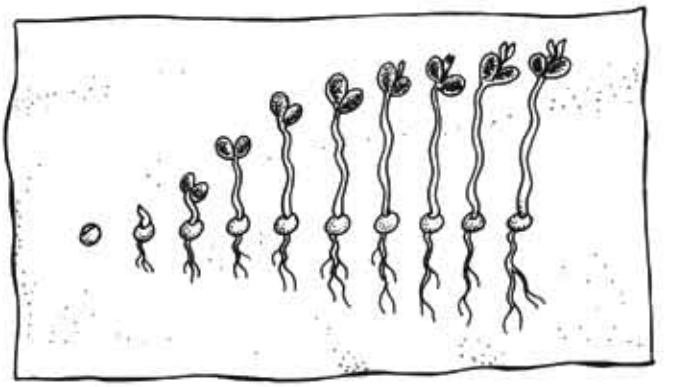


Fig. : Paper towel test

Seed germination and seed vigour test can be done by blotter test and paper towel test of the figures above. In blotter test, seed germination is tested by spreading a wet blotting paper on a pettridish and placing a seed on it. Likewise, seed germination can be done by placing manifolded newspaper on a tray, pouring water to make the paper wet and then by placing a seed on it. Seedling vigor can be tested by observing seedling growth for some days. Seed germination capacity and seedling vigour can be determined by the.

Work: The students will discuss about good and healthy seed selection, collection and storage, write on the poster paper and present.

Lesson 8: Seed preservation

A good seed may turn into bad seed if it lacks proper preservation. It is right for true seed. Seed can be used year after year if it is preserved in the perfect way with containing the qualities mentioned above.

Good and healthy seed preservation techniques: Selection of seed crop starts when crop remains in the field. Proper plant protection measures are need to be taken whether the seed crops can not be attacked by any diseases and pests.

The seed crops are collected at maturity stage and winnowing, sieving and drying should be done so that the seeds may not rupture. The seeds may dry in the open air and sunny place. The rule of seed drying may be different for each crop. Each variety of seed has its specific safety quantity of moisture. The moisture content of rice and wheat seeds range 8-10%. If the seeds beceme too dry, it may crack or its ovule might fracture. Again pathogen or insect may attack if the seeds remain damp than its required moisture content.

How much and how many times of stored seeds remain good depend on the moisture content of seed. Not only moisture content of seed, but also the moisture of the seed container and the store play an important role on the quality of If the container is air tight, the germination capacity of the seeds remain risk-free.

The factors other than moisture that can harm seeds are higher temperature,

intense ray etc. On the other hand, if the properly dried seeds are preserved in an air tight container, those factors have little influence on seeds. In addition, seed container should be stored in a dark and cold place where it is free from rats and insects. Seed container can also be stored in cold storage; in that case a particular place in the cold storage is needed for it. If the amount of seed is not much, then it can be preserved at 5°C temperature in a refrigerator, writing and leveling about acquaintance of seed on seed packet or seed pot. Before storage it should be ensured whether the seeds are capable of being germination.

Lesson 9: Steps of rice seed preservation

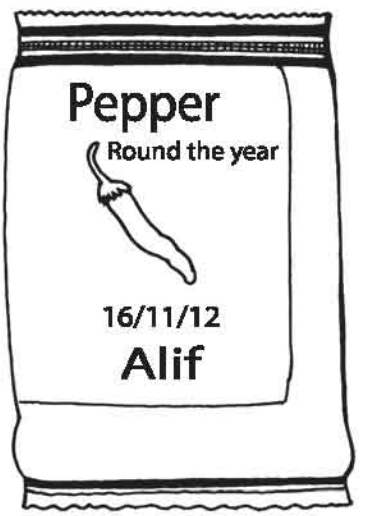
1. It is necessary to produce seed rice in the isolated plots with special care. In this plot, pesticide must spray at regular interval and proper sanitation measure should be taken.
2. Cut down rice with minimum stalk after ripen, dry carefully, bring in the threshing floor and start drying at the same day after threshing if possible.
3. The seed rice is tested by teeth whether it is dried optimum or not. If the seed rice stays in between teeth, it is needed to dry more time. When the seed rice produces a sound "cot", is the symptom of optimum dryness. Moreover, moisture content of seed rice can be measure by using hygrometer in the seed container.

Fig: Seed in the drum

4. It is necessary to keep seed on the shady place for sometimes before storing.
5. It is good to keep container full with seed.
6. It is necessary to level the seed container writing: name of seed, date of preservation, uses of chemical insecticide or not and signature of assigned person.

Steps of pepper seed preservation

1. Collect required amount of pepper fruits from healthy and disease free plants.
2. Cut down or break the fruit and bring out seeds of pepper carefully and put it in the pot.
3. Discard the immature, infested and irregular size seeds and keep the pot containing seeds in the sunlight for drying. It is enough to dry seeds at 2 hours in the scorch sunlight. It is necessary to turn around the seeds with a stick.
4. After drying, it is necessary to cool down the seeds before storing. It is wise to store fewer amount of seeds in the bag containing zipper. Otherwise, store pepper seed in the polythene bag and seal it.
5. Label the packet of pepper seed.



6. Put small packets of seed into a big transparent pot and keep it in the cool and safe place of room.

Exercise

Multiple choice questions

1. Which irrigation method is used in the fruit orchard?

a. Check basin
b. Ring basin
c. Sprinkler irrigation
d. Drip basin

2. The sensible stage of rice cultivation-

i. flowering stage
ii. panicle initiation stage
iii. seed formation stage

Which one is correct?

a. i and ii
b. i and iii
c. ii and iii
d. i, ii and iii

Read the following passage carefully and answer question no. 3 and 4

Polash made 10 beds for preparation of nursery in his village Valuka. At the time of preparation of bed he applies organic, inorganic fertilizers along with lime.

3. How much MOP (kg) does he need the preparation of bed?

a. 1 kg

b. 2 kg

c. 3 kg

d. 4 kg

4. The reason for lime application in bed is-

a. control of acidity of soil

b. control diseases

c. quick seed germination

Which one is correct ?

a. i b. ii

c. i and ii d. i and iii

Creative questions

1. Morshed Mian is popularly known as a conscious and successful farmer in his locality. He always used modern agricultural technologies. In this year, he cultivated 4 hectares of rice in his field after producing green manure crop, dhaincha and follows LCC method for urea application.

a. Which types of soil is suitable for dry seed bed of rice?

b. Why is the seed bad left for 2-4 days after plough?

c. Determine how much reduced amount of urea Morshed Mian will use?

d. Evaluate the activities of increasing crop production of Morshed Mian.

2. Mr. Kabir is cultivating rice in his field by irrigation during long time. In recent time, the production cost has increased in manifold due to increasing fuel price. So, Mr. Kabir talked about the Agriculture Officer. Mr. Kabir took initiative to test soil for the selection of irrigation time. As a result, he needed reduced amount of irrigation water in his field.

a. Which is the main source of irrigation water?

b. Explain the necessity of the selection of good seed.

c. Explain how Mr. Kabir identifies time of irrigation of his field.

d. Evaluate the initiative of Mr. Kabir to reduce production cost of crops.

Chapter Four

Agriculture and Climate

At first, the unfavourable environment and the importance of unfavourable environment on agricultural production are discussed in this chapter. The production process in adverse condition of environment for agricultural production such as drought, salinity, and flood prone areas and sectors they influence including crops, fisheries and livestock are described here.

Then adaptation and mitigation technologies to protect crops, fisheries and livestock from disastrous climatic events including water logging, excess rainfall, drought, hailstorm etc have been described.

Fig: Flood

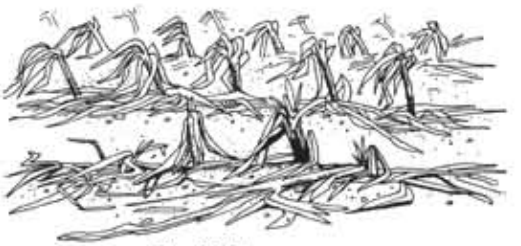


Fig: Hail storm

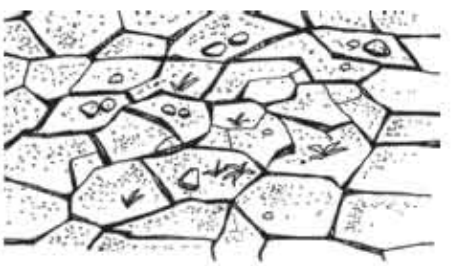


Fig: Drought

At the end of this chapter we will be able to:

- describe agricultural production techniques required for unfavourable climatic adaptations.
- analyse the uses of agricultural technologies to protect agricultural production under unfavourable climatic factors.

Lesson-1: Unfavourable environment and Crop Production

The growth and development of crops become normal if the climate and environmental factors remain unaffected. But natural factors do not remain normal always. In some regions crops have to face climatic and environmental problems in production season. The situation is known as unfavourable environment. Crops in such situation try to set through regulating bio-chemical and physiological changes. This is known as adaptation capacity of the crops.

Now we will try to know which factors related to climate and environment create unfavourable environments. The climatic factors which create unfavourable situations include:

1. Flood and water logging
2. Drought or no-rain conditions
3. Higher temperature
4. Lower temperature

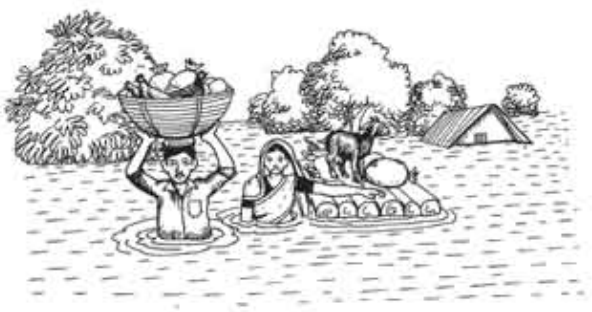


Fig: Flood

The environmental factors which create unfavourable situations include:

1. Soil salinity
2. Presence of chemical toxins in the soil
3. Presence of toxic gases in the air.

The problems of unfavourable factors in Bangladesh agriculture have been existed from a long since. At present due to global climatic changes the unfavourable environmental problems are increasing at higher rate. Three critical sectors have been identified in the agricultural sectors of Bangladesh due to the changing of climate parameters. These are:

1. Drought.
2. Salinity.
3. Floods and cyclones.

The temperature is increasing in the north-western regions of the country due to climatic change. Rainfall is becoming irregular. The drought intensity is increasing in the Boro and Aman seasons. Generally the farmers do not have any preparation for giving supplementary irrigation in rainfall dependent Aman rice season. As a result the yield of rice is decreasing due to such silent droughts. Barisal region of Bangladesh was a store house of food grains once upon a time. Now that Barisal becomes a food deficit area. About 10 lakh hectors of land has become unsuitable for rice cultivation in the south-western region of Bangladesh due to increased soil and water salinity.

About 60 percent area of Bangladesh was submerged due to serious flood in 2007. That flood caused serious damage to aman rice crop. Before mitigation of the damage done by that flood again one highly destructive tornado CIDR more seriously affected Bangladesh. About 13 lakhs tons of crop production were affected by that CIDR.

Bangladesh is a highly populated country. The cultivable land area has been decreasing by 1 percent every year. In contrast population of the country is increasing by 1.39 percent. Besides, the country frequently has to face unfavourable crop production environments.

In this situation we have to know the modern techniques of crop production in order to face unfavourable environmental elements to feed the increasing population.

Work : Write down the importance of producing crops against unfavourable environment as an individual task and present it in the class session.

Lesson-2: Crop production technologies under drought con ditions

Drought is one of the main natural disasters for crop production. Crops in all the seasons are affected by drought in Bangladesh. Drought situation is created due to occurrence of low rainfall or rainless for a long period in a specific season. It causes deficiency of moisture in the soil. As a result the plant suffered from the scarcity of water that hampers the normal growth and development of plants.

This condition is known as drought. Drought can cause a yield loss ranging from 15-90 percent. Crop cultivation may become successfully if appropriate management is taken in the drought affected crop plots. The main management practices are mentioned here –

1. **Cultivating suitable crops or varieties:** The crop or the variety of the crop should be such short duration and drought tolerant that it may be harvested before affected by drought. The examples are: BINA Rice 7 in Aman season, BRRI Dhan -33, which become matured one month earlier than other varieties. For this advantage the rice crop may be saved from the September-October drought. Again in aman season BRRI Dhan -56 and BRRI Dhan -57 are short duration varieties in one side and can tolerate 21-30 day drought period in another side. The wheat varieties such as Bijoy, Pradip, and Sufi are found to be drought tolerant. Cultivating early aman varieties, in drought prone areas, chickpea, lentil, mustard, sesame etc may be cultivated as an additional crops using the existing field with soil moisture. Trees may be cultivated gardening may also be done as it is drought tolerant.

2. **Breaking soil pores:** The land should be given a shallow ploughing when it reaches to the stage at the end of the rainy season in drought prone areas. This operation will pulverize and close the soil micropores. The sun ray then will not cause drying of the soils.

3. **Shallow cultivation:** If it is observed that the moisture of the soil is low, then the land should be ploughed in shallow depth. The soil should be compacted by laddering after every ploughing. It will conserve moisture in the soil.

4. **Mulching:** Soil moisture may be conserved by using mulches consisting dry straw, leaves and vines, water hyacinth covering the planted seed or seedling base. Because water does not evaporate by sun light in this condition. Black polythene sheets are also used for this purpose in many countries. This mulch also reduces weed infestation.

5. **Water storing:** Small canals or trench-pit hole may be prepared in the land during the rainy season in low rainfall areas. This system reduces surface run off of the water. The soil absorbs most of the water directly.

This method of water storage is known as water harvesting. This water may be successfully utilized by plugging the land and sowing seeds night after the rainy season ends.

Fig : Mulch application

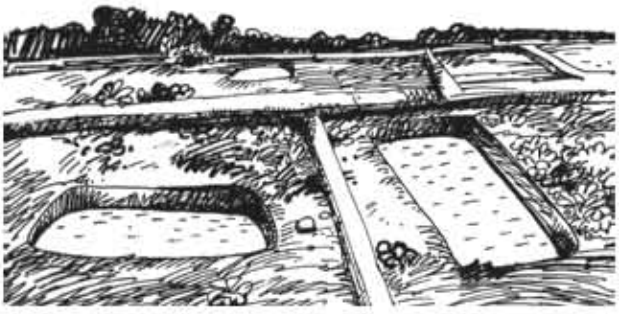


Fig : Water storing

6. Raking: Soil moisture may be conserved by giving raking on the surface soil for few days after germination of seeds when the surface soil moisture tends to be evaporated very rapidly.

7. Changing line direction: Planting of the field should be done making lines against the sun rays in the drought prone areas. In this method the plants gives shades the interline spaces. For that reason, of soil moisture from the inter spaces is reduced in this system. Thus, water loss is reduced.

8. Use of organic fertilizers: Use of sufficient organic fertilizers improves soil physical condition including soil structure. The soil particles become granular and loose. It increases the water holding capacity of the soils.

Work: Students will be divided into groups. Each group will make a list of drought tolerant varieties of crops and present in the classroom.

New Terms Learned: Drought tolerant, Mulching, Water Harvesting.

Lesson -3: Crop production technologies in the saline soil zones

In the first lesson we came to know that salinity of the soil has become a great problem in the southern Agro-Ecological Zones (AEZ) of Bangladesh. We also know that sea water is saline. These southern

coastal zones are flooded by saline water. The concentrations of chloride and sulphate salts of sodium, calcium and magnesium are increased in the soll due to this saline water flooding by sea water. The nutrient element up-taking and water absorption processes by plant from soil solution are affected if the concentration of salts in the soil is increased. It causes reduction of normal growth and development of crop plants. Though salt concentration in the soil remains slightly lower during the rainy season due to wash out process by monsoon rainfall water, salinity was found to be greatly increased in the dry season. This is due to the reason that the salts come out on the soil surface along with the evaporating water during the dry season. The salts make an apparent layer on the soil surface in many areas. The crop production technologies suitable for saline soils are described here –

1. **Cultivating salt tolerant varieties:** We have to select salt tolerant crops or varieties of crops for cultivation in the salinity prone areas. The most salinity tolerant crops are: coconut, betel nut, sugar beet, cotton, turnip, sesbania dhaincha, spinach etc. The medium salt tolerant crops are: hogplum, sweet potato, chili, field bean, mungbean, maize, tomato, guava,etc. Wheat, orange, nashpati, are less salt tolerant. The approved varieties of rice in the aman season for the salinity zones are – BR 22, BR 23, BRRI Dhan-40, BRRI Dhan-41, BRRI Dhan-46, BRRI Dhan-53, BRRI Dhan-54. Rajshail, Kajolshail, Bajail are some local salinity zone varieties of aman rice. The recommended rice varieties for cultivation in the saline zone in Boro season are: BRRI Dhan-47 and BRRIDhan-55.

2. Arranging irrigation and drainage: Concentrated soluble salts are usually leached out of the root of the crop plants along with the drainage water when heavy irrigation is done by raising border of ails. Again if drainage channels are prepared along the root zone layer of the soil, the salts accumulated below the root zone are also leached out from the crop fields. In the situation seeds should be sown ploughing the land as soon as it reaches the jo' stage. This method is very effective in light sandy soils.

3. **Reducing evaporation of water:** Crops may successfully be cultivated if the salt concentration could be kept limited below the root zone in the saline soil. Evaporation of sub-surface water occurs due to sun rays carries salts from the lower

layer to the upper layer of the soils through its macro and micropores when it is wet. This causes the movement of the sub-surface salts from lower to upper layer along with the evaporating water. So the continuity of soil pores should be disrupted breaking or closing it by some processes. In one method if the surface soils are pulverized, loosened or stirred by spade or hand hoes the soil pores can be closed. Thus, accumulate salts remain in the lower soil layers. The seeds of winter crops may be sown ploughing the soils when it is still wet after harvest of aman rice in the saline soil zones. However, several weeding may be needed after germination of seed or planting of seedlings. Weeding should be given in the crops after each irrigation or rainfall in the saline soils. No salt can accumulate on the soil surface if this is properly done.

4. **Preparing land using proper methods:** The delay of the cultivation process of winter crops after the harvesting of aman rice causes accumulation of salts in the upper zone. Land should be ploughed as soon as possible. Power tiller may preferably be used than country plough for ploughing. The land should be well levelled at the time of final ploughing. The seeds sown will germinate better in smooth surface lands. Salts may accumulate in the lower pockets of the undulated soil surface.

5. Changing seed sowing methods: If seeds are sown in broadcast method salts will be concentrated at the upper layer of the soil and there will be less germination of seeds. So seeds may be sown in the bottom of slightly deep furrows made at specific distances. In another way: shallow trench furrows may be prepared at a distance of one meter which should be irrigated for several days. It will increase the leaching of the surface salts in the trench furrows. Then seeds should be sown on the top of the ridges after lightly spading which will encourage good germination of the seeds.

Work: Students will be divided into groups. Each group will make a list of salinity tolerant crops as well as varieties of those crops and present in the classroom.

New Term Learned: Salinity tolerant crops.

Lesson 4: Crop production technologies in the flood prone areas

Bangladesh is affected by flood every year. But in some particular years crops are damaged extensively due to serious type of floods. About three lakhs metric tons of rice are damaged due to a long lasting devastating flood in 1998 in the country. Boro rice at the time of ripening are submerged due to hill flash floods in the north-eastern region of Bangladesh. Again the large middle part of the country is flooded and destroyed at the time of transplanting or after transplanting a man rice. The flood prone areas of the country may be divided into four categories on the basis of the water level during flooding. These categories are:

1. **Medium high land:** The level of the water during flood reaches up to the height of 0.9 meter.
2. **Medium low land:** The level of the water during flood reaches up to the height of 1.8 meter.
3. **Low land:** The level of the water during flood reaches up to the height of 3.0 meter.
4. **Very low land:** The level of the water during flood crosses the height of 3.0 meter. Broadcast aman, deep water aman, transplanted aman, broadcast aus, transplanted aus, and boro rice are cultivated on the basis of the season and areas. Mainly two types of management practices are adopted for producing crops in the flood prone areas. These are:

1. Flood control based management practices: Embankments are constructed on the two banks of the rivers or canals of flood prone areas. Water is controlled by constructed sluice gates in the rivers or canals so the flood water can not enter the crop fields. However, the related environmental issues must be considered critically before establishing such structures.

2. Agronomic management practices: Sudden hill water flash flood happens at the time of boro rice harvest in the north eastern regions of the country. Crops from such floods may be protected cultivating early boro varieties. The rice varieties such as BRRI Dhan-28 and BRRI Dhan-36 which ripen earlier should be cultivated in this flood prone region. Seedling of the age of about 60 days may be transplanted

in the month of January draining out excess water from the field. The crops of these varieties mature within a period of 140-150 days. As a result these rice crops may be harvested at the end of April and thus the flood may be avoided. The approved submergence tolerant BRRI Dhan-51 and BRRI Dhan-52 may be cultivated in the transplant aman season in this region. These varieties have capacity to tolerate 10-15 days submergence under water. The local varieties of deep water aman are also cultivated by the farmers in north-eastern haor regions. The local deep water aman rice namely Bajail, Fulkuri, Harinshail are the varieties which can be directly broadcasted on the soil surface after monsoon rainfall in the months of March and April. This type of rice varieties grow rapidly longer with the rise of water level. It can grow even up to 25 cm per day and can survive at a height of even 4 meter water depth.

Flood affects aman rice crops both before and after transplantation in the mid-zone areas of the country. The farmers can not raise rice seedling due to lack of seedling nurseries in the early flooding areas. Floating seed bed or seed beds in the homestead and other high land spaces may be utilized for raising rice seedlings in these cases. In this case banana leaf or polyethylene sheets may be placed on the prepared seedbed floor where a layer of muddy soil should be given. The seedbed should be kept wet for 5-6 hours and the seeds should be sown densely.

In this process 2.5-3.0 kg seeds may be sown in the seed bed per square meter. This method is known as Dapog method of rice seedling raising. Within two weeks of flood, when water level reduces, the seedling are planted. The late varieties of Aman rice such as Nigershail, BR-22 and BR-23 should be cultivated if the flood prolongs. There is another method of Dapog seedling production. The method is: wetting the rice seeds for 24 hours until the embryo emerge. Then the seeds are kept in earthen pots (Kolsi) or in sacks for 24-72 hours where the seedling develops. The seedlings grown by this method may be sown in the field as soon as the stagnant water comes down from the land.

Work: Students will be divided into groups. Each group will make a list of rice cultivable in flood-prone areas and present in the classroom.

New Terms Learned: Submergence tolerance rice, Deep water aman rice, Dapog seedbed

Lesson-5: Livestock rearing under unfavourable environment

All the animals live within a certain respective surrounding environmental niche consist of the elements of plants, ponds, rivers and canals, weather and climate and its component factors. When all these fators and behaviors do not well suit for animal rearing then it is called the unfavorable environment. Salinity, flood, drought are considered as the reasons of unfavourable environment. The effects of unfavourable environment on livestock and animals are mentioned below:

1. Unfavourable environment create food deficiency of livestock and animal.
2. Scarcity of grass becomes a problem during flood and drought.
3. Grasses and crops do not grow in saline soils.
4. Growth and milk production of animal are reduced.

Fig : Houseless animals during flood

5. The animal faces malnutrition.
6. Many animals dies due to diseases.

What to do during flood: Arrangement should be made in higher lands for the shelter of animals during flood. The permanent animal sheds must be prepared in safe high lands where flood is a yearly event. Broiler and duck farms should be established in flood prone areas instead of layer farms. After only one month broilers can be marketed. Water hyacinth, edible tree leaves, rice straw, banana leaves may be arranged for cattle fodder during floods or flood prone areas. Some wheat and maize grains should be purchased and stored in for native hens. The native poultry do not get down to water. Their feed should be ready made supply. Goats and sheep may be reared in boats and banana tree floats for few days during this flood time. Much care should be taken about the animal disease and sanitation management. Special care should also be taken so that mud can not accumulate in the animal shed.

Preventive injections of probable diseases must be given to the animals before flood occurrence.

Work: The students will individually write in class Exercise copybook about the ways of 'livestock and poultry protection during flood' and will present in the classroom.

Fig: Goats in banana tree floats during flood

Fig: Human and animal under tree shed during flood

Activities to be done during drought. Natural grass production is reduced during flood. Animals should be fed with leaves of different trees as available during this time. Animals should not be allowed to stay directly in fully open spaces during scorching heat. Animals should be kept under tree during hot spell. Sufficient water should be supplied for animal during this unfavourable time. Concentrated feed like oil cake, brans, rice, water etc should be given to the animals along with other available feeds. Injection should be given as per prescription of veterinary doctors.

Cattle fodder like Napier, Para, grass of German varieties may be cultivated as a fodder in drought, flood and saline water affected areas. Besides preserved green grass, sugarcane by-products, banana tree, ipil- ipil leaves are very suitable for giving as feed during unfavourable drought conditions. Algae produced in special methods are also fed to animal in the modern world. All these disaster mitigating technologies may be adopted during stress period.

New Terms Learned: Unfavourable environment, Grain crops by-products.

Lesson -6: Fish cultivation under unfavourable condition and the techniques to protect them in odd weather

Fish cultivation is very suitable in areas where poonds contains some water all the year round, and the probability of flood occurrence trends to be zero or minimum. There are many ecological environments where fish cultivation is not so favourable such as the cultured fish may be lost with pond submerging flood water in the flood prone areas. The fish farmers may seriously be affected. On the other hand fish cultivation becomes very difficult due to the drying of pond water or deep recession of ground water level. Saline water intrusion in the main land water bodies through the coastal belt is increasing due to the rise of sea water level as a result of climatic change. Saline water streams enter the rivers at higher rates through higher tides and increase the salinety level fo river water.

It is causing more salinity of inland and pond water. The yield of sweet water fisheries is decreasing for this reason as yielded before. Mrigel fish does not tolerate soil water salinity. Rui and katla carps are also not growing at the expected higher rates. Not the only unfavourable environment, but also odd weather events like excess rainfall, cyclone and tornado seriously hamper fish production. For example: 1, 39, 478 number of ponds have been affected in 2007 CIDR. The farmers lost 6, 511 tons of fish which market price were about 47. 8 crore Taka. The price of lost fishing boats and nets were about 72.1 crore Taka. The following measures may be taken to manage fish production under unfavourable environment and odd weather events:

1. Harvestable in a short duration and rapidly growing fish species may be cultivated in the drought prone areas. Tilapia may be cultured in ponds of drought areas. Tilapia may be harvested within a period of 4-5 months. Magur may also be cultured in such areas.
2. A long duration and a short duration fish cultivation plan may be taken in drought prone areas. The banks of the ponds of such areas should be made keeping sufficient height and during the period when there's no flood, fish fry may be stocked.
3. Salinity tolerant fish species may be selected for culturing in the water

bodies of saline zones according to its increased salinity ranges. Examples are Bhetki, Bata, Parshe. Initiative may also be taken for culturing shrimp and crabs. Tilapia may also give good yields in these situations.

4. Breach of flood control embankments due to unfavourable environment and odd weather has caused water logging in coastal region. In these areas planned fish culture including cage culture and crab culture may be done.
5. Net thatching with bamboo posts should be done where there may have the possibility of pond submergence and loss of fishes due to excess rainfall.
6. Additional water may be supplemented through pump irrigation in ponds where water volume is reduced and its temperature has been increased.Thus, fish will get sufficient water and the temperature of the water will be maintained at a cooler level.

Work : Discuss in group how fish may be cultivated in areas having probability of drought and flood affects.

New Term Learned : Increase sea water level, Bhetki, Bata, Parshe.

Lesson -7: Crop protection techniques during odd weather

We have learned about unfavourable environment in the first lesson of this chapter. In the unfavourable condition, the climatic and weather elements do not remain in favour for normal growth and development of plants and crops. Man can imagine about this thing in advance. So, they become aware of meeting up of its consequences from crop selection to detailed management of the production techniques. But if the weather becomes disastrous during the production period and damages the crops, then we call it odd or bad weather. Bad weather is short duration event. But bad weather can do a damage in a short period. Even the whole crop may be destroyed. Untimely water logging, excess rainfall, drought, hailstorms, high temperature, low temperature, tornado, water surge, slits etc are the examples of odd weather. Now we will discuss the crop protection technologies from these odd weather events in our country.

weather. Now we will discuss the crop protection technologies from these odd weather events in our country.

1. Water logging: Accumulation and staying of water in a place due to excess rainfall or flood is known as water logging. Water logging due to hill flash flood may submerge boro rice at the time of ripening in the haor areas. If there is a possibility of the crops being damaged by the breach of flood control embarkment, the damaged portion should be repaired immediately. If it is possible the excess water may be removed by cutting drains. Aman rice seedlings may be raised in another high land and may be transplanted in the flood affected main field after recession of the stagnant water. Rapid arrangement should be taken to make available the seed, seedling and fertilizers so that the farmers can use it just after the flood is over.

2. Excess rainfall: Excess rainfall occurs in Bangladesh from June to October. Torrential rainfall for several days is also recorded frequently in the country. It causes water stagnation in many places including crop fields roads and homestead. Many trees incline due to the loosening of the bases. The fruit, medicinal and herbal plants or tress should be bound with straight bamboo posts in such weather situations. Vegetable fields get more damaged by excess rainfall. Stagnant water from vegetable plots removed by cutting drainage canals. Drainage canals or furrows should be cleaned by spading. Vegetables need to be cultivated in raised beds to overcome this situation. A drain of 30 cm width may be made within two beds.

3. Lack of rainfall or drought: Continuous rainless for 15-day duration in the dry season is known as drought. We give irrigation to meet the adverse effects of drought. Supplementary irrigation should be given to Aman rice if rain is not available since it's a rain fed crop. Weeding by hoes should be given to close the soil cracks and macro pores. It will reduce evaporation of water from the soils. Mulching should be done to conserve soil moisture in the vegetable fields during winter season. A pre-sowing irrigation may be given in case of vegetable, rice, jute, in the drought months of March and April to bring jo' condition in the fields or after seed sowing to enhance germination.

4. Hailstorms: Hailstorm is mostly common during the months of March and April. The early winter crops such as onion, garlic, wheat, potato, etc are

damaged by hailstorms. The range of damage depends on the size and intensity of hailstorms. The crops should be immediately harvested if the hailstorm effects seem severe. If hailstorm is mild and crops take longer time to reach in the maturity stage, aftercare including pruning of damaged portions of the plants of the crop need to be intensifed. In the months of April-May, Boro rice, mango, okra, brinjal, chillare may also be affected by hailstorms. The brinjal, chili and okra are affected by breaking branches at the growing stage due to hailstorms. Such crops may be recovered by pruning and cleaning damaged branches or twigs and giving fertilizer and irrigation along with doing other intercultural operations.

Work: The student will prepare a poster individually writing the difference between unfavourable environment and bad weather and thus present in the class session.

New Terms Learned: Bad (odd) Weather

Lesson-8: Livestock protection techniques from bad weather

Every country in the world has its own weather and natural features. It happens in a specific cycle over a year. However, out of these normal phenomena sudden deviations happen in the forms of untimely flood, storms, tornados, excessive rainfall or lack of rainfall, too much cold, earth quake, etc. create severe problems. The uncertain or sudden happenings of the environment are known as bad or odd weather. It should be remembered that unfavourable environment comes every year in a regular sequence, but bad weather comes suddenly. The effects of bad weather on livestock and poultry are mentioned here:

1. It takes time to adapt bad weather by animals.
2. Scarcity of animal and poultry feed occurs.
3. The animals are infected by diseases.
4. The production of milk, meat and egg are reduced.
5. Death-risk arise for various animals.

Fig : Death of animal due to tidal upsurge

There is very little scope to meet up the bad weather effects as it comes suddenly and it is very difficult to solve the created problems. Presently the weather specialists can forecast about the probabilities as to its time and intensity. Some disaster mitigating preparations should be taken according to the weather forecasts. Facing bad weather is a short term activity. But long term planning is required to meet or manage unfavourable environmental events.

The people become helpless during disasters especially during the tornados in the southern and coastal regions of Bangladesh. However, attempts must be taken to protect livestock during disasters.

The animals should be taken to higher lands for shelter in case of sudden water logging and floods. The animal feed including straw, tree leaves water hyacinth and concentrated feed should be collected in advance and should be supplied in time. It many not be possible to allow livestock for outside feeding. In this case the collected feed should be given as stall feeding. Especially jackfruit leaves should be given to goats hanging the branches in front of them.

Fig : Goat eating leaves in bad weather

Fig : Cutting water hyacinth for livestock

The movement of air around the animal house should be controlled to protect them from cold during winter season. Straws should spread over the shed floor. Special care should be taken so that the animals do not get not infected by pneumonia.

The dead animals should be buried under soil. The treatment of animals should be done as per prescription of the veterinary doctors.

Exercise

Multiple choice questions

1. Which is climatic factor that causes unfavourable environment?

a. Water logging
b. Soil salinity
c. Toxic gases of air
d. chemical toxin of soil

2. If the soil micropores are closed-

a. Moisture will be conserved
b. Weeds will be controlled
c. Water logging will be created
d. Fertility will be increased

3. If covered by water hyacinth-

i. Water will be conserved
ii. Nutrient elements will be reduced
iii. Weed infestation will be reduced

Which one of the below statements is correct?

a. i and ii
b. i and iii
c. ii and iii
d. i, ii and iii

Read the paragraph below and answer the question no. 4 and 5.

Mr. Nasiruddin has sown rice seeds in 3 floating seedbeds of 1 sq meter area as per advice of the Agricultural Officer due to the onset of early flood in the month of Ashar.

4. How much of rice seed was sown by Mr. nasiruddin in 3 seedbeds.

a. 2.5-3.0 kg
b. 5.0-6.0 kg
c. 7.5-9.0 kg
d. 10.0-12.0 kg

5. Due to the production of seedling by Nasiruddin in this method-

a. Get the yield in right time
b. Get early yield of rice
c. Get more yield from rice
d. The quality of rice will be good.

Creative questions

1. The lands of Mr. Monindra Roy were flooded by sea water due to the breach of embankments in 2007 CIDR. He sought advice from agricultural Officer as he did not get good yield after the repair of the embankment. The Agricultural Officer then advised and made Mr. Monindra Roy understand as what crops to be cultivated, what management steps should be taken etc. Mr. Monindra now became a model farmer abiding by the advice of Agricultural Officer.

a. In which region of Bangladesh salinity is higher?
b. Why is salinity reduced after rainfall? Explain.
c. What type of crops were cultivated by Monindra?
d. Analyse the reasons of Monindro's success.

2. The farmers of Lalpur village were seriously affected due to low rainfall since several years. In this situation they went to Krishibid Mr. Mjan for advice. Mr. Mijan explained the crop cultivation techniques to be followed under rain-fed condition. According to the advice they collected organic wastes and new varieties of crops. They relieved from the problem following the advice of Mr. Mijan.

a) What is Dapog seed bed?
b) What problems are created if the soil moisture becomes deficit?
c) What are the causes of waste material collection by farmer? Explain.
d) Analyse the crop production technologies under the new management system.

Chapter Five
Agricultural Production

This chapter discusses the production technologies of wheat and mushroom; harvesting and grading of agro-products. The mixed culture methods of fish culture among fish production (rui, katla, mrigel) and shrimp culture are described here. Cattle rearing and its disease management on domestic animals have been discussed here.

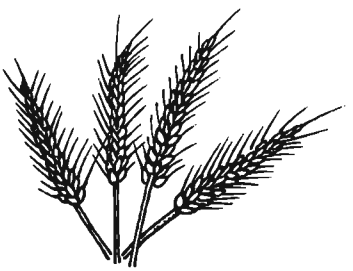


Fig : Wheat

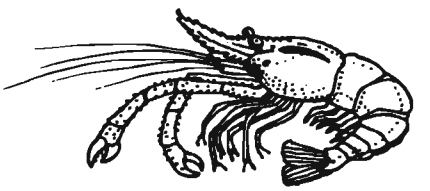


Fig : Shrimp

Fig : Mushroom

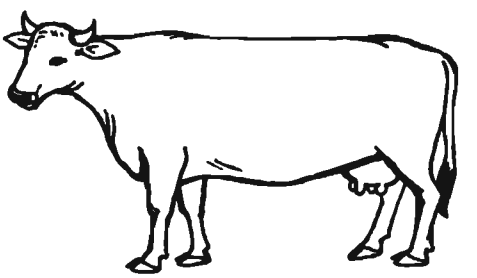


Fig : Cow

At the end of studying this chapter, we will be able to:

- explain crop cultivation methods.
- explain the importance of mushroom culture.
- explain the mixed cultivation methods of fish culture.
- describe shrimp culture methods
- Explain the cultivation method of domestic animals.
- Analise the management and control of disease of these domestic animals.
- Explain the harvesting and grading of agro-products.

Lesson-1: Cultivation method of wheat

The major source of carbohydrate is cereal grain. For this reason, cereal grain crops are cultivated as food crops throughout the world. Wheat is the main staple crops in many countries of the world. Wheat holds the second position of food crops being next to paddy in Bangladesh. Wheat is cultivated in almost all districts of Bangladesh. However, it is cultivated more in the districts of Dinajpur, Rangpur, Thakurgaon, Rajshahi, Pabna, Bogura, Jamalpur, Jashore and Kustia. There are many high yielding varieties which were approved for cultivation in Bangladesh. Kanchan, Akbar, Agrani, Prativa, Sourav, Gourov, Shatabdi, Pradip, Bijoy were found to be very popular among the available varieties.

Time of sowing: Wheat is a winter crop. Winter season of Bangladesh is of short duration. For this reason, wheat seeds should be sown in time to harvest a good yield. The most suitable time of sowing wheat seed is between first week of November to second week of December in our country. Wheat grows best in loamy soils of highland and medium highlands. But the yield of wheat becomes low in saline soils. Kanchan, Akbar, Prativa and Gourab gives better yields where wheat can not be sown in later part of the season due to delayed rice harvest and thus late land preparation.

Seed rate: It is considered satisfactory if the germination of the wheat seed is more than 85 percent. About 120 kg of seeds is required to be sown per hector of land. Many seed born diseases may be prevented if the seeds are treated before sowing in the field. Seeds may be treated mixing 3 grams of Provex- 200 per kg of seed.

Methods of sowing Seeds: The land should be well prepared giving 3-4 ploughing and planking or laddering when the land reach the 'jo' stage. If sufficient moisture is not available, then irrigation should be given once and to

be ploughed at the 'jo' stage. Wheat seeds may be sown as broadcast or in line. If it is broadcast sowing then seeds should be sown during the last ploughing operation and the seeds must be covered by soil through laddering. In case of line sowing, the seeds should be sown in narrow furrows made by small hand hoe after final land preparation at a line to line distance of 20 centimeter. The seeds should be sown at a depth of 4-5 centimeter deep furrows which should be covered by surface soils. Arrangement should be made for protecting the seeds from birds for a period of 15 days.

Methods of applying fertilizers: Two-third of the recommended urea and all the Triple Super Phosphate (TSP), Muriate of Potash (MOP) and Gypsum fertilizers should given at the time of final ploughing in case of wheat cultivation under irrigated condition. The rest one part urea should be dressed extra on the top of soil. For non-irrigated wheat cultivation total quantities of urea, TSP, MOP and Gypsum should be applied at the time of last ploughing of land preparation. The recommended doses of fertilizers needed for wheat cultivation are mentioned below-

Name of fertilizer	**Quantities of fertilizers/hector (ha)**	
	Irrigated	Non-irrigated
Urea	200 kg	160 kg
T S P	160 kg	160 kg
MOP	45 kg	35 kg
Gypsum	115kg	80 kg
Cow dung /compost manure	8.5 ton	8.5 ton

Irrigation: Two or three irrigations should be given according to the texture of the soils. First irrigation should be given at the 3-leaf stage of the seedling, second irrigation at the time of ear emergence and the third irrigation should be given during grain formation.

Weed control: Weed vitally shares the fertilizers and irrigated water of the main crops. Weeding should be given before top dressing the urea fertilizer. Irrigation should be given after top dressing. At least 2 weeding operations should be done to keep the wheat field free from weeds.

Crop harvest: The leaves of the plant start yellowing at the onset of wheat grain maturation. The grains will come out during thumb-palm rubbing at maturity. At this stage wheat plant should be harvested by cutting after which it should be dried, threshed and winnowed.

Work: Students will write the process of wheat production as individual work and present it in the classroom.

Lesson-2: Intercultural operations and other technologies of wheat cultivation.

Wheat cultivation in zero tillage: The harvest of Transplant Aman is delayed in many areas. As a result time land preparation becomes a limiting factor for sowing wheat seeds. In this situation wheat can cultivated with zero tillage. If sufficient soil moisture is available after harvest of rice i.e. leg spots during walks become prominent, then seeds may be sown directly on the soil surface. Again if [o' situation is absent then seeds may be sown after giving a light irrigation. At first wheat seeds should be soaked in cow dung water suspension for several hours. Then the seeds need to be dried extracting seeds from the suspension. It creates a wrapping layer of cow dung over wheat seeds. As a result birds do not eat the wheat grains after seed sowing and do not dry due to sun radiation. Fertilizers may be applied using two methods when wheat cultivation is done in this system-1) Fertilizer broadcasting during sowing of seeds, 2) Fertilizer broadcasting during first irrigation after 17-20 days after seed sowing. It is needed to control weeds 25-30 days after seed sowing.

Wheat cultivation in minimum tillage: Seeds of wheat may be sown giving two ploughing using country plough. The land should be ploughed just at the jo' stage after the harvest of transplant aman rice. Again if jo' situation is absent then seeds may be sown after giving a light irrigation. At first one ploughing and one laddering should be given. All the fertilizers and seeds should be broadcasted after the second ploughing and laddering. First irrigation should be given at 17-21 days of seed sowing. Urea should be top dressed at the time of first irrigation. It is found better if weed is controlled at 25-30 days of seed sowing.

Disease control in wheat cultivation: Insect-pest and disease infestation are not found to be a great problem in wheat cultivation. However some fungal diseases may appear. Besides rat infestation is a significant problem many times. Leaf rust disease, leaf spot disease, foot rot disease, loose smut and black spot diseases are the major fungal diseases among others.

At first small round yellowish spots are visible on the surface of the leaves. At the later stage the colour of the spots become rusty brown to blackish. Reddish rust powders are found on the hand fingers when the diseased leaf is rubbed. The symptoms of this disease are first appearing in the older leaves after which it spread to all leaves and the stem. In the leaf spot disease symptoms first appear in the lower leaves in the form of small oval spots. Then the spot expands in size and causes blight of the leaves. The causal organism of this disease survives in the waste crop residues and stay in the seed. Yellow spots are produced at the base of the plant at soil level in foot rot disease.

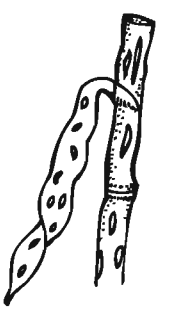


Fig : Leaf rust disease

Then the colour of the spot becomes deep brown and encircles the surrounding of the infected portion. Then the plant dries out and dies.

Fig : Loose smut disease

The symptoms of leaf rust disease are visualized at time of ear emergence of wheat. The infected ears are found to be wrapped by a thin membrane at the initial stage. Later the membrane burst which is seen as black smuts. Brown or blackish spots of different sizes are found to occur on the wheat grain seed cover due to black spot disease.

Black spots extend up to the embryo of the seed and gradually the whole seed is infested by this disease.

Integrated control measures should be taken to prevent these fungal diseases of wheat. The disease resistant varieties of wheat such as Kanchan, Akbar, Agrani, Prativa, Sourav, Gourab, should be cultivated. The seeds should be collected from disease free wheat plots. Wheat seeds must be treated before sowing in the field. Fertilizers should be applied following balanced formulation.

Rat is the main enemy for wheat cultivation. The infestation of rats initiate from the time of ear emergence. It causes serious damages at the ripening stage of wheat. Handmade or homemade poison traps or purchasing this type of traps from the market may be used for rat control. These poison trap materials are kept at the movement ways or newly dug holes of rats near rat furrows on soil surface. Besides poison traps rats may be controlled using other traps made of bamboo or wood.

Work: Students will divide in groups and discuss zero tillage wheat cultivation and minimum tillage wheat cultivation and present it in the classroom.

Newly learned: Zero tillage method of wheat cultivation, minimum tillage method of wheat cultivation, leaf rust disease of wheat, loose smut disease of wheat.

Lesson 3: Importance of mushroom cultivation

We know that fungus are responsible for so many plant diseases. But all the fungi do not cause any disease. There are many fungi who are beneficial for us. Mushroom is such a type of fungi which is fully suitable as food, it is tasty and has medicinal qualities. Actually mushroom is a kind productive part of saprophytic fungus which are edible.

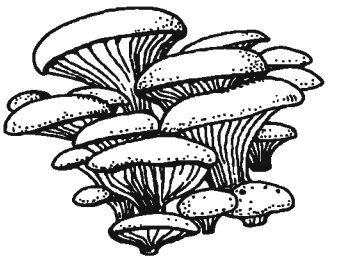


Fig : Mushroom

Mushroom and umbrella of toads are not same thing. Naturally grows here and there with toxic fruiting bodies are called umbrella of toads. The thing is 'mushroom' is a type of vegetable grown in safe and clean envi-ronment from the seed or spawn developed through tissue culture. Mushroom itself is a kind of tasty food, and also it increases the taste of other food when used or mixed with other food items. Taste of mushroom is similar to meat. Most delicious Chinese type and other meals of 5-star hotel level are produced with mushroom. However, mushroom is used for cooking country methods for meal items like vegetables, fry, soup, polao, biriani, noodles, shrimp, and small fish preparations. Mushroom may be eaten as fresh, dried up and ground powder.

Mushroom is top level crop when considered for nutrition point of view. Because, it contains very essential food elements, such as: protein, vitamin, and minerals at a very high level. Every 100 gram mushroom contains protein 25-35 grams, all vitamins and minerals 10-15 grams, carbohydrate and fiber 40-50 grams, and fat 4-6 grams. The protein of mushroom is of very high quality grade. This protein contains all of the essential 9 amino acids. Eating of this protein reduces the danger of high blood pressure, heart disease, obesity. Because, this protein does not contains any harmful fat. Besides, the fats of mushrooms help in increasing the activities of calcium and phosphorus in developing bones and teeth. Mush-room carbohydrates contain so many types of chemical elements which work for remedy from complex diseases.

Vitamins and minerals create resistance power against disease in the body. Our body has a need for specific quantities of vitamins and minerals. We can meet up that required vitamin and mineral needs by eating mushroom daily. Mushroom

is found to contain thiamin (vitamin B-1), riboflavin (vitamin B-2), niacin etc and minerals in sufficient quantities such as: phosphorus, iron, calcium, copper etc. Mushroom works both to prevent and cure many diseases such as: diabetes, heart disease, high blood pressure, anemia, dysentery, dropping of hair, cancer, tumor etc due to high quality food values.

A healthy typical human needs to uptake 200-250 grams of vegetables per day. We usually eat 40-50 grams of vegetables (except potato) per day. It is very low considering the total requirement. For the reason we frequently suffer from different diseases due to deficiency of vitamins and minerals. The cultivable lands are reducing very rapidly in Bangladesh. Most of the lands are now used for rice cultivation. It is very difficult to increase land for vegetable cultivation. In the situation mushroom may be a very potential crop. Mushroom is such a type of crop which does not need very high fertile soils for its production. It may be cultivated in house in racks. It can be grown in a very short period of 7-10 days. The climate and weather of Bangladesh is very suitable for cultivation of mushroom. The raw materials for mushroom cultivation namely rice straw, saw mill wastes, sugarcane stubbles, rotting leaves etc are chief and easily available.

Mushroom cultivation is commercially very profitable. Because, mushroom requires low capital and labour investments.The invested capital can be recovered within a very short period. On the other hand more production and profit and high market rates may be obtained per unit of land. So, the unemployed youth can find their job works very easily through mushroom cultivation.

The family nutrition can be met side by side it is possible to be benefited financially through the cultivation of mushroom in every house.

Work: The class teacher will show through a poster or video the importance of mushroom cultivation and a success story of mushroom producer in the class room. Accordingly the teacher will give direction to the students to write in class Exercise Khata and present about the importance and nutrition of mushroom as individual and group works.

Lesson- 4: Cultivation methods of mushroom

There are many species of mushroom cultivated in different seasons. Milky, Rishi and Straw mushroom may be cultivated in summer season, while Sitake, Button, Simaji and

Inoki may be cultivated in the winter season. The year round Wester mushroom is mostly cultivated in Bangladesh. There are some differences in the cultivation methods of various types of mushrooms.

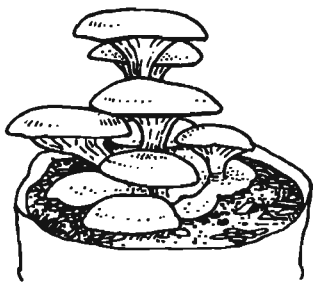


Fig : Wester mushroom

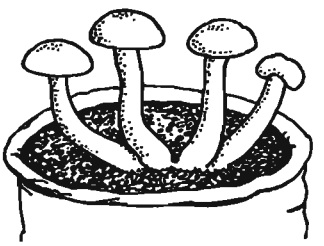


Fig : Milky white mushroom

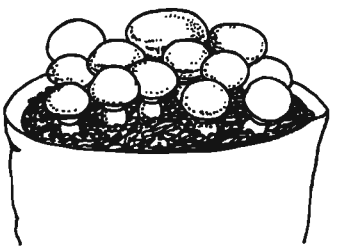


Fig : Button mushroom

Here in this lesson we will know the cultivation methods of Wester mushroom.

Preparing spawn or mushroom seed: Mushroom seeds are produced in the laboratory through tissue culture methods. Packaged seed is available in the market for purchasing by mushroom farmer which are known as commercial spawn. However, farmers themselves may also produce spawn locally using the straw method. Mushroom farmers have to produce the spawn collecting mother spawn from the market in this case.

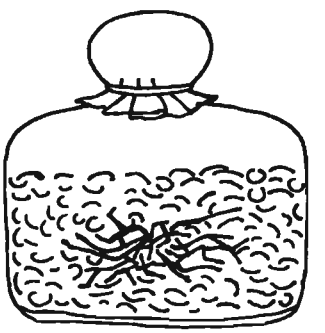


Fig : Commercial spawn

Preparing the culture house: Sufficient number of windows should be kept in the mushroom culture room for air and oxygen movement. There should be shadowed light in the house. Arrangement should be made so that the temperature of the culture house remains within the range of 20-30 Celsius. Mushroom favours higher relative atmospheric humidity. The relative humidity of the culture house should be in the range of 70-80%. Enormous carbon dioxide is produced in the culture house due to respiration high population of microorganisms. The carbon dioxide gas is found to accumulate in the lower layer of the house as it is comparatively heavier. For this reason, the lower part of the thatch or wall should be kept open.

Collection of Spawn: Spawn seed prepared in poly pack system should be collected from reliable farms after construction of the culture house. The main characteristics of a good spawn that it will be white and the packet is uniformly and fully filled with fungal mycelium. Arrangement should be made to cut the collected spawn packet as soon as possible. If there is any possibility of late cutting of packet then it should be removed from the sack and should be kept in a separate cool place of the house.

Cutting the packet: The mushroom spawn packet should be soaked in water after cutting it in correct method before setting in the culture house. The cut should be made along the shoulder and including corners making a size of 2 inches long and 1 inch radius. The white portion of both sides of the cut piece should be scratched with a blade. Then the packet should be soaked in water for 5-15 minutes. After soaking and draining out the water the packet should be placed on the floor or racks in line for its culture.

Aftercare: The seed spawn should be placed at a distance of 2 inches on the floor or racks in line. Water should be sprayed in the house 2-3 times in winter and 4-5 times hot seasons as per need to maintain the relative humidity 70-80% around the spawn packet. Spraying should be done keeping sprayer nozzle about one foot above the packet. The packet or sack may be moistened to control the humidity and temperature placing news papers below and above the packet.

Other cares: The germination mushroom seed will initiate producing a pin like embryos within 2-3 days if care is taken properly. The small embryos should be pruned keeping 8-12 big embryos at both sides. Mushroom may be harvest within a period of 5-7 days. The harvested mushroom should be kept at rest. The cut side of the mushroom again should be scratched with a blade next day followed by spraying. Mushroom may be harvested 8-10 times from each packet. About 200-250 grams of mushroom may be harvested from one packet.

Mushroom Harvest and Preservation: Mushrooms should be softly pulled by hand for harvest at the stage when it becomes sufficiently large but the stalks and veins do not seem loose. The mushroom to be marketed putting it in polyethylene bags after cutting and grading. The polyethylene bag should be made air tight through proper sealing the opening. This mushroom may be eaten 2-3 days keeping it in cool dry place. Mushroom was found to remain good 7-8 days in freeze.

Work: The students get divided into two groups. Discuss about the cultivation methods of Wester mushroom and present separately in the class session.

New learning: Saprophytic fungi, Productive parts, Culture house, Spawn.

Lesson -5: Harvesting and grading of horticultural crops

Fruits, vegetables and flowers are rapidly perishable products. About 50% of the products are stated to be damaged during processing, grading and marketing through indigenous country methods. This is a serious loss on economic and nutritional point of view. The fresh appearance, respective tastes, colour, flavour and other qualities of all the products may be fully maintained taking integrated management practices from harvest to marketing stages. As a result product degradation is reduced and high market prices are ensured.

We harvest fruits, leaves, twigs, embryos, roots, stems, buds etc of horticultural crops for our use. Commercial maturity of crops is mostly considered for its harvest time decisions. The commercial maturity of an edible part of the crop means that stage at which it can be eaten keeping intact its food value, flavour and other characteristics. For example, we harvest and marketing at different stages of growth of cucumber, gourds, brinjal/eggplant, country bean, okra, leafy vegetables etc. Fruits may be divided into two groups. There is one type of fruits in which transformation of carbohydrate to sugar is stopped. The examples of this type are pumelo, lemon, grapes and litchi. This type of fruits must be harvested after its ripening. Again mango, jackfruit, papaya, banana, wood apple etc continues transformation of carbohydrate to sugar, spread flavour and attain colour. This type fruits may be harvested before full ripening of the fruits.

The horticultural crops must properly be harvested, cleaning, pruning, grading, packing transporting and marketing for getting good market price. The fruits may be degraded due to loss of water due to evaporation, transpiration, respiration making it wrinkled if the harvested products are not properly processed. Increased temperature increases the rate of respiration and damages cells and tissues of the fruits. Infection by pathogenic microorganisms may cause diseases and damage the fruits.

We have to take the following steps to protect the products from different types of losses:

1. **Crop harvest index/indicators:** We consider the commercial maturity and have to harvest in right time.
2. **Methods of harvest:** Products of horticultural crops are harvested mainly in two methods, a) By hand and b) By mechanical tools. The following points must be kept in mind while we harvest horticultural crops.-
   a) Harvesting should be done very carefully so that no damage happens during that operation.
   b) Avoiding damages during harvest by hand nails, knife and other equipment such as lesion on the skin, twisting of the stem, lodging on the soil, mudding of the fruit surface, sunning etc.
3. **Crop storage containers:** The products after harvest should be kept clean containers. The container must be such that it does not make any damage to the products. We usually use jute sack, plastic basket, bamboo or cane basket for storing horticultural harvests.

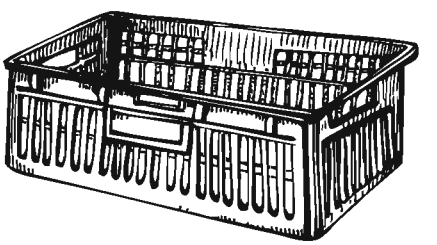


Fig : Plastic basket

4. **Carrying from field:** Much care should be taken while carrying horticultural production from field to the place for grading. The container should not be forcefully thrown elsewhere. The products should not be packed so tightly. The transport vehicle should be driven slow enough so that no destructive jerking of the products happens.
5. **Temperature:** The products after harvest from the field must be protected from direct sun. Sun radiation increases the temperature within the fruits causing damage of the quality of fruits. Horticultural crop products should be harvested in the morning or evening. The products should be taken from the field as soon as it is harvested.

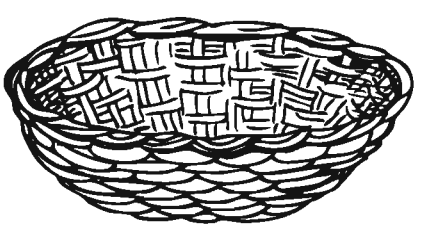


Fig : Bamboo basket

6. **Grading of products:** The unwanted and inert waste materials at first should be screened and removed from the harvested and transported products. Then the products should be graded according to size and shape into several categories. Finally the products should be packaged for marketing. We usually pack products in sack, polythene sheet, plastic basket, bamboo and cane basket and paper or wooden box. The packaged products must be kept in cool environment until it is transported to the target market.

Work: The students get divided into groups. Discuss the sequential steps starting from harvest of horticultural crops to marketing of the products and present it in the class session.

New terms learned: Commercial ripening, Grading of products.

Lesson-6: Harvest and grading of field crops.

We have already known about field crops in class six. There are many steps which are required to be sequentially followed from crop cutting after ripening to the hands of consumers. The products may be degraded or damaged in terms of quality due to lack of appropriate caring methods. As a result the farmers do not get fair price of the products. The integrated method involving all the steps from crop cutting to marketing can significantly reduce the post harvest losses, as mentioned below:

1. Timely harvest of crops: Grains must be harvested at full maturity of the crops. That is the crop should be cut after full ripening. However, the weather of time should be seriously considered. For this reason crop can not be harvested during wet stormy weather. Besides it can not be threshed, winnowed and dried during the period. The harvested crops if stacked may be rotten due to higher temperature raised in the compact stack and produce odour. However, in case of possible storms or floods, the crops required to be harvested before full ripening of the crops.

Irrigation in the crop field must be stopped 15-20 days before harvest. It will control physical growth of the plants and enhance maturity of the crop. Rice may be harvested when the colour attain golden colour or about 80% of the grains found to be matured. The pulse and oil seed crops should be harvested

when the plants become yellow or start dying. The crops may be harvested when the grains mature. But if the crop is over matured then some grains may be shattered during crop cut and transport. Rice and wheat crops may be harvested by cutting it with the help of sickle or other similar tools.

2. Threshing: The harvested crops may be rapidly threshed if the harvested crops are well dried after cutting. The grains are not damaged during threshing. Peddle thresher and powered mechanical threshers are utilized for rice and wheat. Again these crops may also be harvested beating it over drums or mat floors manually. The threshing floor should be fully cleaned before starting crop threshing. The pulse and oil seed crops must be fully dried before threshing after harvest. Threshing is done by cattle if the volume of the harvest is large. Otherwise threshing may be done using strong sticks or bamboo stems (lathi).

3. Winnowing: The threshed materials should be lightly dried after separating it from the harvest waste inert. Then the grains are winnowed by bamboo trays (kula), air or power driven fans. The straws, empty grains and other inert waste materials are removed from the harvest products due to winnowing.

4. Crop drying: The crop grains should be well dried after threshing and winnowing. The moisture content of grains is reduced to certain level through drying. The grains should be dried for 2-3 sunny days until it makes a 'Kot' sound when cut by teeth. The moisture of the grains reaches the range of 10-12 per cent at this stage. The grains may be degraded, infested by disease, rotten or damaged in the godowns or stores if its moisture content is higher.

5. Transport: The grains when hot after drying should not be pored in to sacks or containers. It should be transported to the godowns or house stores after it is fully cool using jute or polyethylene or synthetic sacks. The worn out sacks should be avoided for carrying grains. Transportation may be done by powered vehicles if the product volume is higher. Much care should be taken during loading and unloading grains from the vehicles so that the sacks are not damaged.

6. Storage godowns: The room space or place where products are kept for different tenure of the time is known as godowns. The sacks or containers are kept over a bamboo or wooden made framed floor mats (matcha) in the godowns or house stores. Grains are mostly kept in jute sack, polyethylene lined sacks, bamboo made containers namely dol', soil made container motka,

plastic drum, tin drum in our country. Godowns always must be kept clean. It will reduce pest and rat infestation. The insect-pest infestation was found to be reduced if neem leaf is placed at different layers of the grain products. The god owns need to be frequently visited to check up the conditions. The moisture of the grains should be tested and may be again sun dried if it is needed.

Fig: Dol

Fig: Storing in jute sack

Work: The students get divided into groups. Discuss group wise all the steps starting from crop harvest to storing into godown and present it in the class sessions.

Lesson 7: Advantages of mixed culture of fish and its suitable pond for mixed culture fish

Culture of different species of fish in the same pond is called mixed culture of fish. Fishes that are not carnivorous in nature, do not compete for feed, live in different layers of water and take feed from different layers can be cultured in the same pond. Carp type or Rohi type fish are suitable for mixed culture such as Silver carp, Rohi, Katia, carpio etc. Indigenous carp type fishes such as Rohi, Katia, Mrigel are notable. They are highly suitable for mixed culture in pond.

Advantages of this type of fish culture are given below–

- They consume feed from different layers of pond such as Katla intake feed
- from upper layer, Rohi from middle layer and Mrigel from bottom layer.
- They are not carnivorous
- Have good immunity
- Fast growing
- Fingerlings are easily available in the hatchery
- Can grow with low cost supplementary feed
- Tasty to eat and high market demand

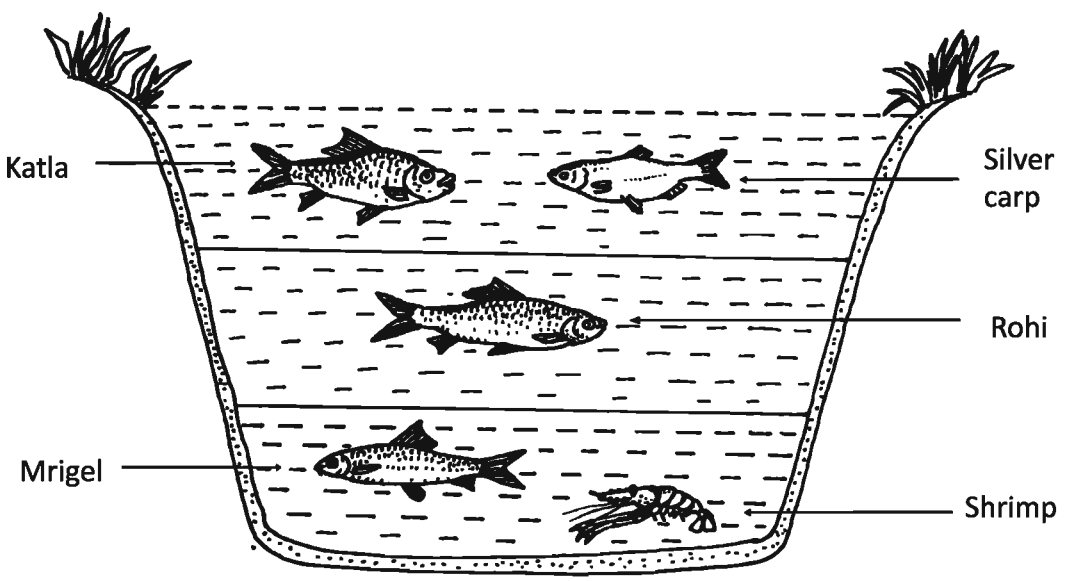


Fig : Ideal pond for mixed fish culture

Work: The Student will attend group work on advantages of mix culture, write it on the poster paper and present it in the class room.

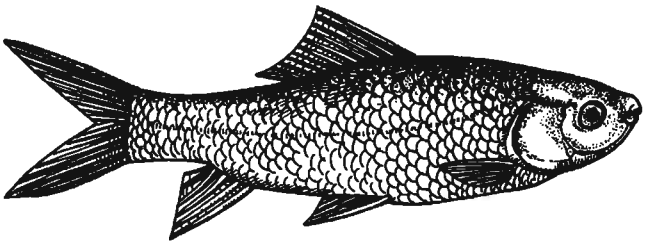


Fig : Ruhi Fish

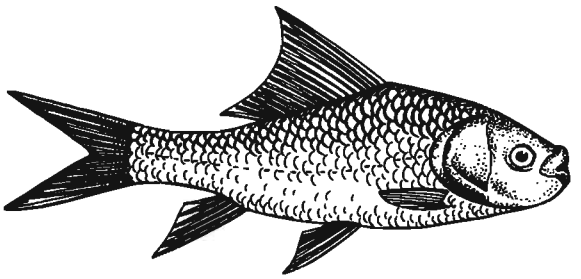


Fig : Katla Fish

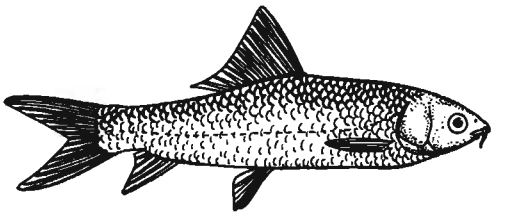


Fig : Mrigel

Advantages of mixed culture:

- Fishes are living in different layers of water and they consume feed from different layers. For this reason, all water body of pond and all feeds in the pond are utilized properly.
- Feed is not pilled in a particular layer and no wastage of feed. As a result the environment of pond becomes good.
- Disease infestation is less in mixed culture.
- Overall production is high.

New Word: Carp fish, Hatchery

Lesson 8: Ideal pond for mixed culture

The following points should be considered in selecting ponds for mixed culture-

1. Pond should be free from flood. For this purpose the bank of pond must be high and strong enough.
2. Average water depth of pond should be 2-3 meter and during dry season depth of water will not less than 1 meter.

3. Loamy, clay loam or clay soil is best for preparation of pond. Because water holding capacity of that soil is high.
4. There should not be any big tree on the east, west and south bank of the pond.
5. The pond will be located in open area for easy access of light and air.
6. Size of pond should be 30-50 decimal for better management.

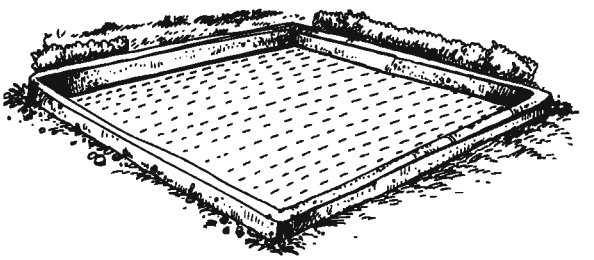


Figure: Ideal pond for mixed fish culture

7. There should not be any carnivorous fish and harmful insect.
8. The pond should be free from weed.
9. The bottom layer of the pond should not be too muddy.

Fish lives in water. The water quality of pond directly affects aquaculture. The following characteristics should be considered for the water quality of a productive pond -

1. Depth of water: Plankton is the natural feed of fish. Sunlight is necessary for the production of plankton. If the depth of the pond water is more, then the sun rays cannot reach the bottom of the pond. In that case sufficient plankton will not grow. On the other hand, if the depth of water is low, the temperature of the water rises and weed may grow at the bottom of the pond.

2. Turbidity of water: The floating soil particles and mud are responsible for the turbidity of water. On the other hand pond water may turbid after raining. Turbidity prevents the sun rays from entering in to a deep layer, and as a result no natural feed is produced for fishes. It damages the gills of fish. In order to prevent this problem application of 240-250 g of fitkiri per decimal per 30 cm depth of water or 1.2 kg straw per decimal will be helpful.

3. Colour of water: The occurring of deep green colour of water or algae layer of the pond is harmful for fish production. If some tiny bags containing 12-15 gm "Tute" is kept in per decimal water body, it will be mixed with water with the help of wave and will prevent algae bloom. There may be a red layer on the top

water of the pond due to excess iron or red algae. It reduces the oxygen content of water. Algae bloom can be removed by drawing twisted straw or banana leaves rope over the top of the water. If the colour of water is light green, reddish green and brownish green then it indicates adequate natural feed of fish 'plankton' has grown.

4. Temperature: The amount of dissolved oxygen increases with decreasing temperature of water and the rate of feed consumption of fish reduces. On the other hand the rate of feed consumption increases with increasing temperature of water. For this reason reducing the application of fertilizer and supplementary feed during winter season. 25-300 temperature is best for ruhi type fish production.

5. Dissolved gas: Fish takes the required amount of oxygen for respiration from dissolved oxygen of water with the help of gill. The oxygen content of pond water is reduced due to excess rotten characteristic of animal/ plant and algae, cloudy environment, turbidity of water, excess iron etc. present in water. At the same time the amount of carbon di oxide and others poisonous gas increases. When oxygen level reduces in pond water, fishes come to the top of water and takes feed with gasping. In order to remove this situation beating pond water with bamboo and swimming in the pond may be helpful.

Work: The student will draw an ideal pond for mixed culture and list out the characteristics of water of a productive pond and submit to the teacher.

New words: Plankton, Turbidity of water, Gill, Fitkiri, Red algae.

Lesson 9: Preparation of pond for mixed culture

Agricultural land should be prepared through ploughing, irrigation, application of fertilizer etc. before planting of seedlings for crop production. In the same way pond should be prepared before releasing fish fry to the pond. The steps of preparation of a pond for fish culture are described below–

1. Reconstruction of bank and bottom of the pond: The bank of the pond should be reconstructed if there is any breach over here. Pruning should be

done if there is any big tree on the bank of the pond. It helps to make available sunshine to the pond and natural feed will be produced. Poisonous gases will be produced if there is an excess mud at the bottom of the pond. For this reason pond should be dried for several days at every 3-4 years and the excess mud should be removed.

2. Weeding: The aquatic weeds such as water hyacinth, khudipana etc. absorb nutrients from plankton (natural feed of fish) and prevents to fall sunshine to the pond. So, all aquatic weed should be removed from the pond.

3. Eradication of carnivorous and other unwanted fish: Shol, Gojar, Chital, Boal, etc. carnivorous fish engulfs cultured fish fry. On the other hand unwanted fishes

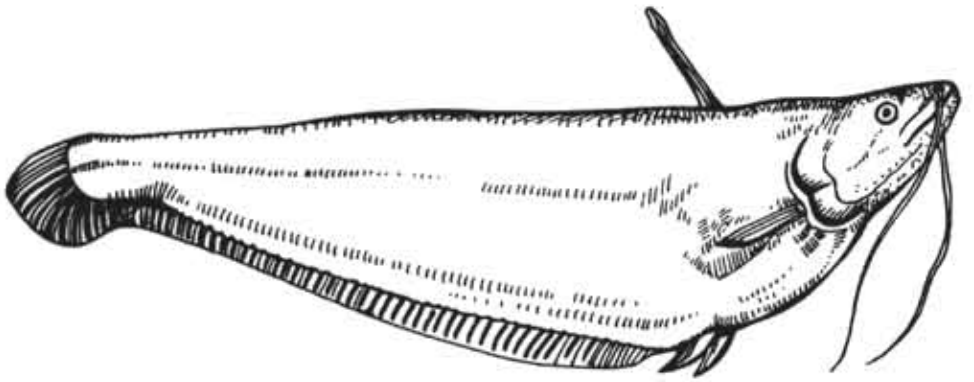


Fig : Boal Fish

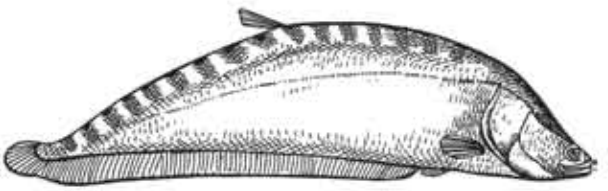


Fig : Chital Fish

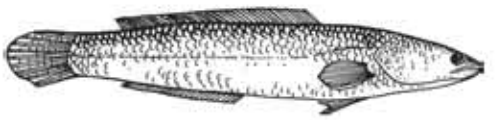


Fig : Shol Fish

compete for feed with cultured fish. These unwanted fishes may be controlled either by drying of the pond or by frequent netting, If the water content of the pond is lower. About 30-35 grams of rotenone powder mixed with water is to be spread over the pond for one fit or 30 cm depth per decimal of pond water and subsequently stirring of water. After a while all fishes should be collected when they will float on the top of the pond. Dead fish using rotenone are safe for consumption.

4. Application of lime: About 1-2 kg lime powder per decimal of pond should be spread at the bottom if the pond is dry. If there is water in the pond the measured amount of lime is first to dissolve with water in a pail or drum and then cooled and the lime solution is uniformly spread to the pond. Lime purifies the soil and pond water and also increases the fertility of the soil. Lime also removes poisonous gas and turbidity of pond water.

5. Application of fertilizer: Natural feed grows in the pond after application of the fertilizers. The fertilizers should be applied after 7-10 days of lime application. Among organic fertilizer 5-7 kg cow-dung or 3-4 kg litter and among inorganic fertilizer 100-150g urea, 50-75g TSP and 20-30g of MOP should be applied per decimal of pond. After 5-7 days of fertilizer application, pond water should be tested either natural feed grown or not and after that fish fries should be released in the pond.

Work: Students will test the presence of natural feed with the help of teacher in any adjacent pond.

Testing natural feed in the pond water: After 5-7 days of fertilizer application it should be tested whether natural feed developed or not in the pond water. For testing, a 20 cm diameter black and white tin plate (Secchi disk) should be hanged with a thread and immersed in pond water. If the plate is invisible at 25-30cm depth of pond water, it indicates that adequate natural feed has grown. The test can be done in another way. That is- one should immerse his hand in pond water up to his elbow. If the palm of his hand is invisible, it indicates that adequate natural feed has grown. Otherwise small amount of fertilizer is applied over the pond and again it should be tested 2-3 days later.

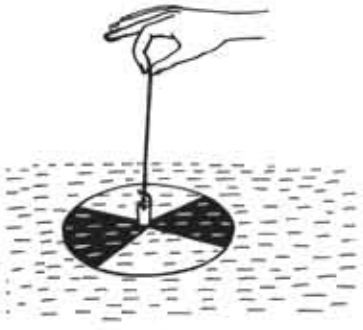


Fig: Secchi Disk test

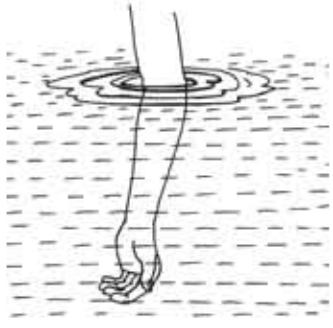


Fig: Hand test

New words: Secchi Disk, Hand test

Lesson 10: Collection of fish fries and care after stocking

Collection of fish fries: Fish fries should be collected from any adjacent government or nongovernment hatchery or nursery pond. The fish fries may be transported in aluminium or earthen pots in shorter distance. For a long distance, it may be carried in polyethylene bags with oxygen supply. The fish fries brought from hatcheries should not be directly released to the pond. The fish fry polybag or the container should be floated over the pond water for about 15-20 minutes. At that time water of the pond should be given in the container or polybag in small lots. This operation will gradually equalize the temperature of the container water and the pond water. After that the polybag or the container should be gradually poured into the pond water by slanting it slowly, and the fish fries will be released into the pond water. The fish fries of 7-10 cm can be stock 25-40 per decimal. The fish fries have to be released in the pond in morning or afternoon in cold weather. 7-10 cm Size 25-40, fish fries stock in the pond within per hundred. Katla 10 -16, Rui 7-12, Mrigel 7-12 fish fries may stock in the pond. If other foreign fish are cultured with these, in that case silver carp 7-12, Katla 3-4, Rui 5-8, Mrigel 6-10, Carpio 1-2 and Grass carp 2-4 to be released. Moreover this 10-15 thai puti fry can be released per decimal of pond.

Care after stocking of fish fries

1. **Application of fertilizers:** If there is no sufficient natural feed in the pond the fish fries will not grow properly. So, the fertilizers should be applied every day or every week after stocking. Fertilizers should be spread over the pond by dissolving with water.

Figure: Techniques of releasing fish fries to the pond

List of fertilizer applied to the pond

Name of fertilizers	Dose (weekly per decimal)
Cowdung or Chicken-duck litter	2-2.5kg or 1-1.5kg
Urea	40-50g
TSP	20-25g

2. Application of Supplementary Feed: Every day supplemental feeds are applied after stocking. For making balanced feed fish meal, mustard oil cake, wheat bran/rice polish, flour and vitamin mineral premix are mixed in the proportion of 20: 45: 4.5: 0.5 and supplied to the fish. The mustard oil cake to be used should be kept moist in water for about 10-12 hours. Moist mustard oil cake and other ingredients should be mixed properly and it may be applied to the pond giving it a shape of small balls. The required and measured whole feed may be divided into two parts and one part may be given in the morning and the rest portion should be given in the evening. On the other hand fish feed prepared in feed mill available in the market may also be supplied to the fish. It is good enough to supply 2-5 percent supplementary feed of total fish weight present in the pond in summer season and 1-2 percent supplementary feed of total fish weight in winter season.

3. Disease management of fish: Different types of diseases attack the fish during fish culture. Fishes may attack with pathogenic microorganism and also die if the environment of the pond is not good. As a result fish cultivation becomes unprofitable. Necrosis of fish, tail rot, fin rot, swelling of abdomen and mite may attack the fish during cultivation. When fish is attacked with the disease it swims abnormally on the surface of pond water, decreases feed consumption or stops feeding, colour of gill becomes pale and necrotic symptoms on the skin are seen etc. If any diseased fish is observed in the pond, it should be removed as soon as possible.

Primarily 1kg lime or 25-35gm potassium permanganate per decimal may be applied to the pond or the infected fish should be soaked with salt solution (10g salt dissolved with 10 liter of water) for one minute and again it should be released in the pond.

Work: Teacher will show a video footage on supplementation of feed regarding mixed culture of fish and give group work to the students.

Harvesting of fish: Ruhi, Katla, Mrigal etc. usually grow very rapidly up to one year. After that, the feed consumption increases but reduces growth rate. For this reason, it is very important to harvest the fishes at the right time. Otherwise the cost of production will be increased. Ruhi and Mirgel fishes may grow up to 700 grams to one kg in a period of 9-12 months and Katla become 1-1.5 kg in a period of 7-12 months.

New Word: Potassium permanganate

Lesson 11: Selection and preparation of pond for Shrimp culture

Shrimp is an important fisheries resource in the economy of Bangladesh. 80% of the export income from fish and fish products comes from frozen shrimp. The position of shrimp sector is just after garments industry, regarding earning of foreign currency. The raw materials in shrimp industry like prawn fries are available in hatchery and natural sources in the country. In this industry we earn more by investing less. We can earn foreign currency, generate employment opportunity and improve socio-cultural condition by expanding shrimp culture. There are 67 species of shrimp in the reservoirs of sweet and saline water of Bangladesh. All of these species could not be cultured profitably. In our country the important commercial fresh water prawn species is Galda

saline water prawn species is Bagda. The size of head and body of Galda is almost equal. Male Galda has two pair leg and which is comparatively large. In case Bagda prawn, the head is smaller than body. At present, yearly shrimp production in Bangladesh is about 75 thousand metric ton. Here we will learn about cultivation techniques of fresh water Galda shrimp. In spite of single culture, Galda may also be cultivated with carp fishes.

Selection of pond for Galda farming: Galda can be cultivated in small, large or all types of pond. But large pond is better for Galda farming. The pond should have the following characteristics for Galda farming-

1. The pond should be open enough to reach sufficient sunlight.
2. Loam, clay loam or clay soils are suitable for shrimp culture.

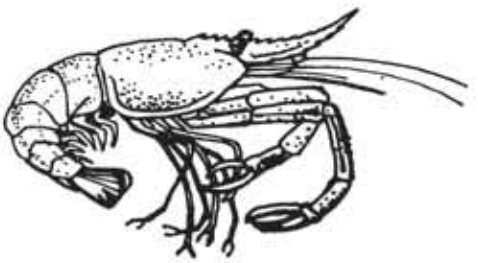


Figure: Galda shrimp

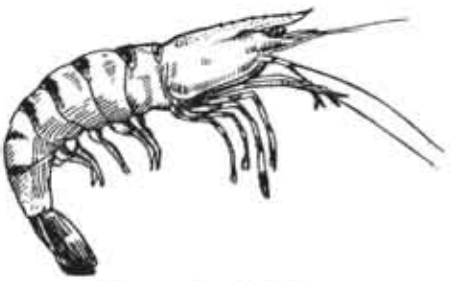


Figure: Bagda shrimp

3. Depth of pond should be 1-1.2 meters.
4. There should have irrigation and drainage facilities.
5. The pond should be free from flood.
6. Pond should be free from pollution.

Work: The students will write down the "importance of shrimp as an economic crop" and present group wise.

Preparation of pond: We already discussed about preparation of pond for fish culture in previous chapter. Pond preparation for fresh water shrimp is same as previous discussion. Different steps of pond preparation for fresh water shrimp are discussed briefly:

1. The bank of the pond should be reconstructed if there is any breach over there and excess mud should be removed from the bottom layer of the pond.

2. The predator and uncultivable fishes may be eradicated from the pond either by drying the pond or by using rotenone.
3. Floating and other aquatic weed should be removed from the pond.
4. Lime is applied at the rate of one kg lime per decimal of pond. Lime reduces acidity of soil and water, removes turbidity of water and also increases efficiency of fertilizer.
5. The fertilizers should be applied after 7-10 days of lime application. We already learnt from previous chapter about the amount of fertilizer to be applied.

Lesson 12: Stocking of prawn fries and management after stocking

Usually 3-5 days after application of fertilizer the colour of the water becomes light green and then stock should be done. Shelter of Galda prawn should be established before stocking. The prawns change their sloughs after a sudden period of time. Usually prawns grow by changing their sloughs. The prawn becomes weak after changing of sloughs. At that time prawn needs safe shelter. For this reason dry branches of coconut, palm, date palm and pieces of bamboo may be fixed in the ground of the pond where shrimp take their shelters in those places.

The size of prawn fries should be 10-15cm collected from natural sources or hatchery and released very carefully after adjusting with pond water. Stocking should not be done during heavy rains or sunshine. In case of single culture 40-120 prawn fries can be released per hectare. In single culture 40-120 prawn can be released per decimal of pond in case of mixed culture 48 prawn, 6 silver carp, 7 Rui, 7 katla, 1 Grass carp and 1 thi puti for fries can released per decimal of pond.

Observation of water: Pond water should be observed regularly after stocking of prawn fries. After 2-3 months of stocking if the colour of pond water becomes deep green or the prawn shows abnormal behaviour then the pond water should be changed.

Application of fertilizer: Application of fertilizer is necessary to produce natural feed in the pond. For this reason, 150-200g cow-dung, 3-5g urea, 1-2g TSP and 0.5-lg MOP per decimal should be applied daily. Fertilizer should be applied in the morning before falling sunlight to the pond. The application of fertilizer should be stopped when the colour of water will deep green.

Feed management: The growth of fish becomes satisfactory if supplemental feed is applied along with natural feed. In order to prepare balanced died, rice polish or wheat bran, oil cakes, fish meal, oyster shell meal, salt and vitamin mineral premix should be mixed and it may be applied to the pond giving it a shape of small balls. The feed should be applied to the pond water at the rate of 3-5 per cent of the stock weight every day. Snail or oyster flesh cutting into small pieces may be applied in the pond daily in order to enhance the growth of shrimps. The ball size wet feed should be given in a feed through placed in the pond. The required and measured whole feed may be divided into two parts one part may be given in the morning and another in the evening.

List of feed supplementation for shrimp

Sl. No.	Feed ingredients	Amount (%)
1	Rice polish or wheat bran	40-60
2	Oil cakes	10-20
3	Fish meal	20-30
4	Oyster shell meal	9.5
5	Salt	0.25
6	Vitamin mineral premix	0.25

Work: The students will make group wise discussion on the importance of natural and supplemental feed for shrimp culture and present in the class.

Prevention of diseases: Shrimps may be attacked with diseases through polluted environment, stocking of diseased prawn fries, high temperature etc. But prevention of disease is always better than cure. The chance of disease reduces if stocking of healthy fries and good management can be ensured. There are some diseases which can be found during cultivation of shrimp such as black markings in slough, tail and gill, softness of slough, algae layer in shrimp body, white muscle and yellow muscle etc. Pond water should be changed as soon as possible if any disease observed during shrimp culture. In order to remove this problem one kg rock lime per decimal may be applied to the pond.

New word: Shelter of shrimp, Fish meal

Lesson 13: Collection and selection of fish

Fish is a rapidly perishable product. After harvesting of fish, proper care should be taken during collection, selection and preservation to reach the fish to the consumer with maintaining its quality. Decomposition starts rapidly in fresh fish if care and preservation are not done properly. Careful handling is necessary during collection and selection of fish so that it cannot be damaged. The equipment used for handling of fish should be in such type that it may be cleaned easily and it cannot damage the fish. Damaged, rotten or diseased fish should be removed rapidly. Fishes should not be kept longer time under direct exposure of sunlight. In case of large fish, blood should be removed if necessary. For this reason, flow of water may be applied to the fish. The chances of bacterial infection will be reduced if we soak the fishes with water containing bleaching powder. For this, 25-30mg bleaching powder should be dissolved in 1 liter of water. If bleaching powder is not available, clean tape or tube-well water may be used. Selection should be done according to species and size of the fish. Again it can be graded in several grades according to the quality of fish like-

Grade	External condition	Muscle	Gill	Eye	Value or grade
1	Bright and glittering, normal colour	Rigid and elastic	Deep red	Bright, glittery and lens high and clear	Best
2	Brightless, light reddish yellow	Rigid and elastic	Brown or pale	Colourless eye and places inside, eye lid opaque, little bit bloody	Medium or satisfactory
3	Reddish yellow	Muscle little bit soft and losses elasticity	Brown and opaque	Colourless eye and places inside, eye lid opaque, little and bloody	low quality bloody

Work: Teacher will collect different specimens of the same fish and the students examine the quality of fish and divide the fishes in different values or grades according to quality.

Generally icing is done for the preservation of fish after harvesting and before marketing. In our country broken ice of ice block is used for fish preservation. Equal amount of ice and fish is enough for the preservation of fish in winter and almost double amount of ice is needed for the preservation of fish in summer season. In our country fish is transported in traditional system using bamboo or coarse mat made basket, in this way the basket is to be filled with fish and ice in several layers and lastly the basket will be tied with the help of bamboo slips or coarse mat and then placed in wooden box for transportation. Chilling van is better for fish transportation in long distance. Heat insulator ice box is needed for fish transportation in relatively nearer distance.

New word: Bleaching powder, infection, elastic

Lesson 14: Care and rearing system of cattle

In order to make livestock production in terms of meat or milk profitable suitable rearing system should be followed. Generally traditional cattle rearing system is followed in our country. No definite system is followed here. In general the farmer rears their animals in cattle shed. Sometimes they keep in tethering or allow the animal for pasturing. So, there are three systems by which animal can be reared these are.

1) Rearing in animal shed, 2) Tethering outside the shed, 3) Rearing in pastureland

Rearing in cattle shed: Animal can be reared in full confinement by making modern animal shed. Total number of animals should be kept in mind during preparation of the cattle shed. Single rowed house may be constructed if the number of animals is 9 or less and made double rowed shed if the number is 10 or more. During preparation of shed there should have the arrangement for feed alley, manger, cubicle, gutter and central alley for movement of animal. Require amount of feed such as green grass, straw, concentrate and water can be provided to shed. Animal can be reared by this system if there is no sufficient pastureland or open space for tethering. In this system animal get less light-air and deceive from sunlight.

Tethering outside the shed: It is an alternative way of rearing if it is not possible to supply the green grass to the animal shed. In that case animal can be tethered in road side, homestead garden or field where natural green grass is available. Owner should keep in mind that the animal should be tethered with peg very carefully otherwise it will destroy the crop of others field.

Rearing in pastureland: Generally people, in the countries where they have sufficient agricultural land, cultivate high yielding fodders for their animal. Typical pasturelands are only present in the developed country. Animal takes their required amount of grass from pastureland by grazing. In that case concentrates are provided in animal shed.

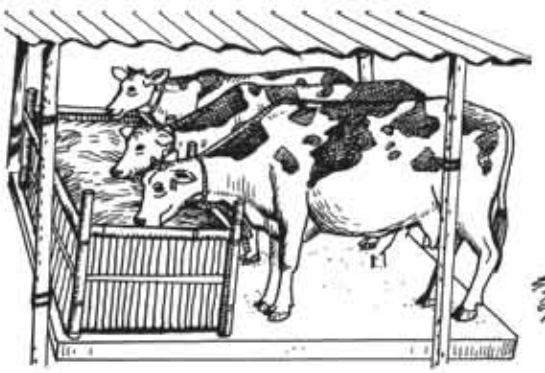


Fig: Rearing in animal shed

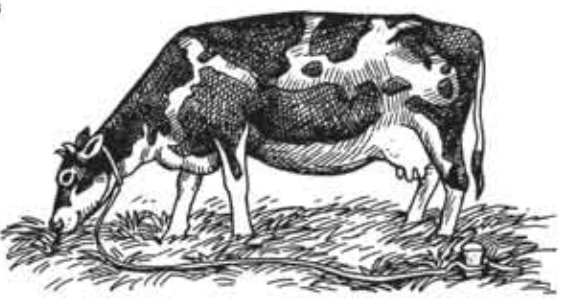


Fig: Tethering outside the shed

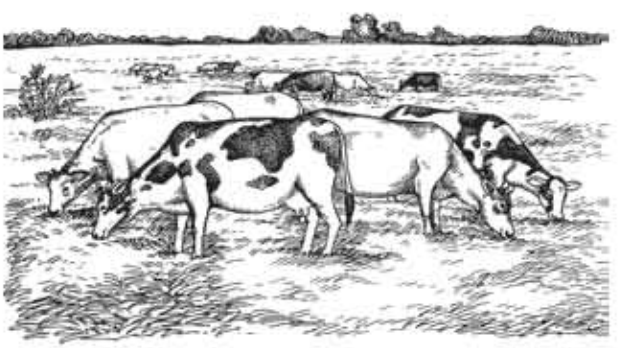


Fig: Rearing in pastureland

Work: Mention the cow rearing system which is followed in your locality and present the advantages and disadvantages of this system in the class.

Care of animal: Proper care should be taken during rearing of the animal. Care means overall management of animal. Milk production of dairy cow reduces if proper care is not taken. Special care should be taken in case of calves, growing cows and pregnant animal. The following points should be considered for proper care of animal-

1. Regular cleaning of shed by removing all dung and urine from dwelling place of animal.
2. Fresh feed should be provided and refusal feed should be removed from the manger.
3. Ensure sufficient clean water supply regularly.
4. To keep the animal clean regular washing is needed if necessary brush may be used.
5. Special care should be taken during breeding, whole pregnancy period and during delivery of animal.
6. Teasing of dairy cow is strictly prohibited during milking.
7. In case of calf special care should be taken and it should bear in mind that the calf gets required amount of milk from its mother.

New words: Traditional system, care of animal, pregnancy period, delivery period.

Lesson 15: Ideal animal shed for rearing of cattle

Usually the importance of shelter for animal and bird is similar to human. Cattle shed should be constructed for higher production and keeping animal in healthy environment. The comfortable shelter given during feeding, resting is called animal shed or byre house. It is better for animal health if sometimes the animals are kept in open space instead of keeping 24 hours in confinement.

Selection of suitable place for an ideal animal shed: The farmers should consider the following factors regarding the preparation of cattle shed for both family and commercial farming-

1. Shed should be constructed in high place.
2. Should be considered the number of animal.
3. It should be far from dwelling place.
4. The soil should be able to absorb water easily or should have proper drainage system in farming area.
5. Surrounding of animal shed will be clean.
6. It should bear in mind that sunlight will be available over cattle shed.
7. Feed and water arrangement for animal should be kept in mind.
8. For commercial farming, transportation and marketing facilities should be considered during preparation of shed.

If a single or herd of cattle are reared in shed, management will be very easy and production cost will be reduced.

The advantages of rearing of animal in shed is discussed below-

- Individual and proper care of animal is possible.
- We get more milk and meat from animal.
- Animal can be protected from excess sunlight, rain or storm.
- It protects from insect and wild animal.
- Milking can be done easily.
- Animal becomes docile by keeping animal in shed.
- Prevention of disease is possible.
- Easy to treat the animal.
- Easy to clean the cattle shed.
- It becomes easy to manage dung and waste materials.
- Less manpower is required and production cost is reduced.

Usually the size of animal shed depends on the number of animals to be kept. If the number of animals is 10 or more then doubled rowed house is better but if the number 9 or less then single rowed is enough.

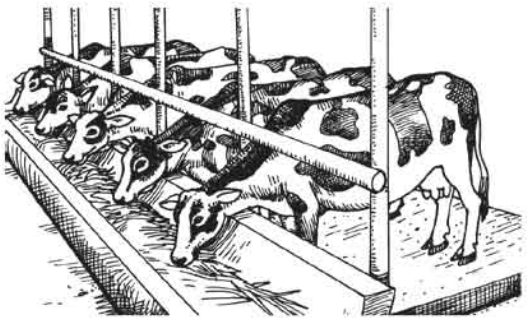


Figure: Single rowed animal shed

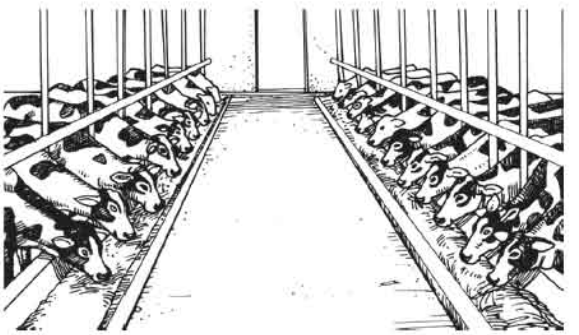


Figure: Double rowed animal shed.

Work: The students will divide themselves into groups and write the importance of ideal animal shed and finally present in the class.

New word: Proper care

Lesson16: Feeding management of cattle

Generally cattle take large amount of roughages for being ruminant should be provided green roughage, straw and concentrate as feed. Normally concentrates are not provided to the indigenous cow due to their low milk production. But high yielding cross breed cow produces more milk and for this, required amount of concentrate should be provided along with green grass and straw.

Green grass: Green grass is the main feed item of cow. But we have always shortage of green grass for animal in our country due to absence of pastureland and open field. For this reason, we have to cultivate high yielding improved variety of fodder in fallow land, bank of pond, road side, brink of rail line and edge of embankments etc. Napier, Para, German, Guinea and indigenous grass can be cultivated as improved fodder. Tree leaves (foliage) such as ipil-ipil, mango tree leaves, banana leaves, jackfruit tree leaves, water hyacinth can be fed to the

animal instead of green grass. Without thrown away, garbage of kitchen vegetables and covering of fruits can also be provided as feed to the animal. 3-4 kg of green grass per 100 kg body weight should be provided to the improved or cross breed dairy cow. So, daily 12-15 kg green grass should be supplied to the cattle according to their weight.

Straw: In our country cattle cannot be reared only with green grass. So rice straw should be supplied along with green grass. 1 kg of rice straw per 100 kg body weight should be supplied to the improved or cross breed dairy cow. So, daily 3-5 kg rice straw should be supplied to the cattle according to their weight. If we soak the rice straw in water after cutting them to soften then it will be advantageous to the animal during ingestion and digestion. Instead of individual feeding straw should be supplied by mixing with oil cakes, bran spume of boiled rice and 200- 300g molasses. This mixed feed improves cattle health and increases milk production of dairy cow.

Concentrated feed: Grains and their byproducts are used as concentrated feed for livestock. The amount of concentrated feed supplied to the dairy cow daily should be divided into two parts, supply one part in the morning another in the evening before milking. 2 kg concentrate is supplied for first 3 liters of milk production and another 1kg concentrate should be supplied for next every 3 liters of milk production.

Work: How much concentrated feed will be required if a Jersey cow produce 12 liters of milk daily? Calculate individually and present in the class.

The lists of concentrated feed given below:

Concentrates	Amount %
Wheat bran	40
Rice polish	20
Broken maize	20
Mustard oil cake	20
Total	100

Maize

Oil cake

Bone meal

Broken wheat

Mineral salt: 100-120 g salt and 50-60 g bone meal should be supplied to a dairy cow regularly.

Water: High yielding dairy cow can take up to 40 liters of water daily. So, sufficient drinking water should be supplied regularly.

New words: Roughage feed, concentrated feed, Cross breed cow, molasses.

Lesson 17: Diseases of cattle

Cattle help us lot. But cattle may be attacked many diseases as human. The milk and meat production and work ability reduce in diseased animals. Many animals may die due to lack of proper care and treatment. So, the farmers should have general knowledge about diseases of animals. Disease and its prevention will be discussed in this lesson.

Disease: Any deviation from normal health is called disease. Diseased animal will take less feed. The diseased animal will show drowsiness. Difficulties may be in urine and stool passing. In many cases temperature of animal increases and the hair may straight over skin. The diseases of animal can be divided into four groups, such as-

a) Contagious diseases

b) Parasitic diseases

c) Mal-nutritional diseases

d) Other diseases

Figure: A sick cattle

A. Contagious diseases: The diseases which are transmitted from diseased animals to healthy animals are called contagious diseases. These diseases are caused by bacteria and virus. Contagious diseases are more dangerous than others. Contagious diseases which are caused by viruses are more harmful such as foot and mouth disease, rabies, cowpox etc. Important contagious diseases caused by bacteria are black quarter, anthrax, swelling of udder, calf pneumonia, diphtheria etc.

Foot and Mouth Disease: All pair hoofed animals can be affected by Foot and Mouth Disease. It is a contagious viral disease. Normal animals are

affected through saliva, feed and air.

Symptoms: Papules are found in hoof, mouth and in tongue. Papules turned into abscess and saliva secrets from mouth. Temperature increased and loss of appetite. Animals become weak gradually. Sometimes death occurs. Death rate of calves or young animals is high.

Fig : Foot and mouth disease

Black Quarter: This disease affects the animal at six months to two years of age. It is a bacterial contagious disease. This disease spreads through wound and faces.

Symptoms: Black Quarter affected animals show the following symptoms.

1. Shows lameness.
2. Swelling found in different region of body and feels pain.
3. Swelled region become rotten and affected animal die within few hours.
4. Infected area makes a kind of sound when pressed.
5. Body temperature rises upto 104-105^0 F.

Anthrax: Anthrax is a contagious disease caused by bacteria.

Symptoms: Symptoms of Anthrax disease are as follows:

1. Anthrax affected animals fallen down to earth
2. Body temperature increases upto 104-105^{0}F and hair becomes straitght.
3. Blood is seen in natural openings (Mouth, nose and anus) of dead animal.

Fig. Anthrax affected cow

B. Parasitic diseases: The small creature which takes shelter in large animal body is called parasite. They live and take nutrition from host body and also bred here. Parasites are classified into two groups such as-

i) Ectoparasites: Such as lice, mosquito, fly, tick, mite etc. They live over the skin of host and do harm by sucking the host blood.

ii) Endoparasites: They live inside the animal body and usually they are known as worm. Worms looks like as leaf, tape or round this is why they are known as flat worm, tape worm and round worm. They take their nutrition from host body and the animal become diseased or weak.

C. Mal-nutritional disease: The diseases may occur in livestock due to deficiency of any of basic nutrients such as protein, carbohydrate, fat, vitamin, mineral and water is known as mal-nutritional disease. The requirement of vitamins and minerals in human and animal body is lower than other nutrients. Deficiency of these two elements is mainly responsible for different mal-nutritional disease such as- lowering vision power, retarded growth, roughness of skin, late risen of tooth, bowness of bone, milk fever etc.

D. Other diseases: Other diseases like flatulence, diarrhea and indigestion etc. are generally caused by irregular feeding, providing stale or rotten feed and polluted water. Special attention regarding this is necessary during supplying feed to the calves

Work: The students will list out the causes of disease group wise and present in the class.

New words: Contagious diseases, flat worm, tape worm and round worm.

Lesson 18: Disease management of cattle

Disease management is very important for a farm. Diseases of animal can be managed through prevention and control. Measures that are taken to avoid diseases in a farm are called preventive measures. After spreading of disease in a farm treatments and other measures may be taken for controlling of diseases.

Ways of prevention of disease of animals: There is no alternative of hygienic management to keep the animals healthy and productive. There is a proverb in medical science "prevention is better than cure". So, there should have adequate preventive measures of diseases in the farm to maintain continuity of production. The preventive measures that have to be taken in a farm given below are-

1. Regular cleaning of cattle shed and surrounding of shed and keep them dry.
2. Prevent entry of dog, cat and other wild animal to the farm.
3. Human entrance should be controlled.
4. Regular vaccination of diseases.
5. Timely administration of anthelmintics to control parasitic worms.
6. Supply balanced diet to the animal
7. Cleaning of feed and water through regularly .
8. Supply fresh feed and clean water to the animal.
9. Separate the animals with different age if possible.
10. Prevent animal from heavy hot and cold environment.

Work: Teacher will show a video on the ways of prevention of disease at animal farms and assign students individual work or group work.

Measures for the diseased animals: If there is any disease seen in animal control measures should have to be taken without being afraid. The following points should be followed during spreading of disease -

1. If any symptom of disease is seen in the animals sick animal should be kept separately from healthy group.
2. Treatment of diseased animal.
3. Observation of diseased animal in the separate house.

4. Examine blood, face and urine of sick animal if it is necessary.
5. Do not market the diseased animal.

Work: The students will divide themselves in groups and find out the measures to be taken for prevention of disease and group wise submit to the teacher.

New words: Contagious diseases, flat worm, tape worm and round worm.

Lesson 19: Collection and selection of egg

Egg is a fragile and perishable product. Two types of egg are produced in home or in farm. Eggs that are used for chick production are called hatching egg and that are used for consumption are called table egg. Cock is required for the production of hatching egg but it is not required for the production of table egg.

Collection of egg: After laying of egg, it should be collected, selected and preserved immediately. Hens that lay eggs in cages can not break the egg and eggs remain clean. Hens that are reared on the floor lay eggs in the litter instead of laying box. Sometimes it becomes a habit of these hens. Eggs on litter become dirty and difficult to clean. Besides this, due to thin shell there is a possibility of breakage of eggs on the floor. Another problem of laying eggs on the floor is consumption of egg by hens itself. If once it starts, it becomes a vice. Egg of hen should be collected twice a day. Egg should be collected at 12.00 pm and 4.00 pm. But egg of duck should be collected once a day. Because, ducks lay eggs within 9.00 am in the morning.

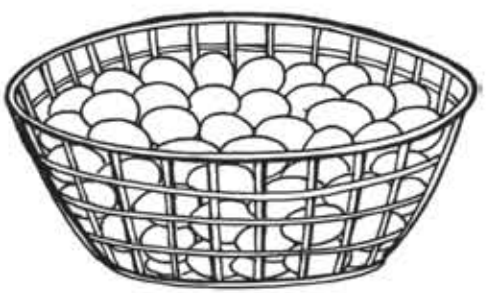


Fig: Collected eggs in a basket

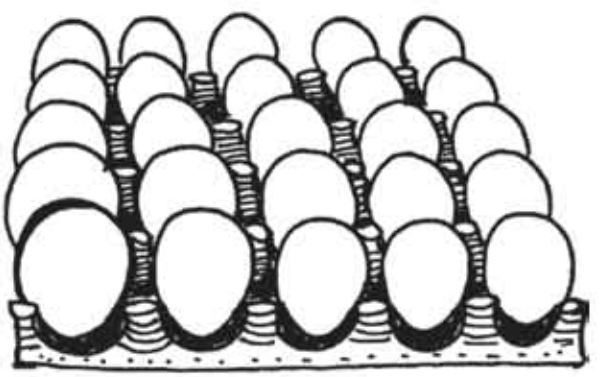


Fig: Selected eggs in a tray

Selection of egg: Selection of egg is done after collection. For hatching egg, extra large, tiny size egg, round shape egg and long shape egg should be discarded. Dirty egg, cracked and thin shelled eggs are not selected for hatching purpose. Table egg can be washed with water if it is dirty. After collection of table and hatching egg it should be kept in plastic tray. When eggs are kept in the tray, large end of the egg should be kept in up and small end down. After that eggs are kept in a cool place. Hatching egg should be stored at 50-55^{O}F (10-12^{O}C) temperature to prevent it from spoiled. Table egg can be stored in earthen pot or by dipping in oil for long time. But the hatching egg can be stored up to 3-5 days at summer and up to 7 days at winter.

Work: Teacher will show a video on egg collection and selection or supply eggs to students. Students will be asked to write the characteristics of good quality egg and present in the classroom.

Grading of egg during selection: Eggs are sold as hali (4 pieces) or in dozen in our country. Eggs are not sold on weight basis in the market. Large size egg contains more nutrients and that's why egg should be sold on weight basis. During selection of egg, it is categorized according to size and weight in the following way:

Grading list of Egg (Chicken)

Serial No	Size	Weight of an egg (gm)
1	Extra large	More than 60 gm
2	Large	53-59 gm
3	Medium	46-52 gm
4	Small	38-44 gm

New words: Hatching egg, table egg, litter

Exercise

Multiple choice questions

1. Which is the main feed of cattle?

a. Straw b. Green grass

c. Concentrated feed c. Herbs

2. What may be controlled by spraying water in the mushroom culture house?

i. Humidity

ii. Temperature

iii. Carbon dioxide

Which is correct?

a. i. b. ii.

c. i and ii d. ii and iii

3. Why formation of sugar from carbohydrate is stopped after harvesting of fruits?

a. Banana, lemon, litchi b. Wood apple, banana, grapes

c. Papaya, grapes, pumelo d. Grapes, litchi, lemon

Read the following paragraph and answer the question no. 4 and 5.

Mr. Hafiz cultivated mixed carps in a pond measuring 40 decimal of 1 meter water depth in front of his house. But he could not harvest expected yield though he had taken appropriate measures.

4. How many numbers of fries of 70-10 cm length can Mr. Hafiz release in his pond?

a. 2000 b. 2100

c. 2200 d. 2300

5. What is the cause of not getting the expected production from the pond of Mr. Hafiz?

i. Low production of natural feed

ii. Water quality was not good

iii. Area of the pond was large

Which is correct?

a. i and ii b. i and iii

c. ii and iii c. i, ii and iii

6. What is the name of packaged seed of mushroom culture?

a. Spawn b. Spot

c. Milky d. Button

Creative questions

1.

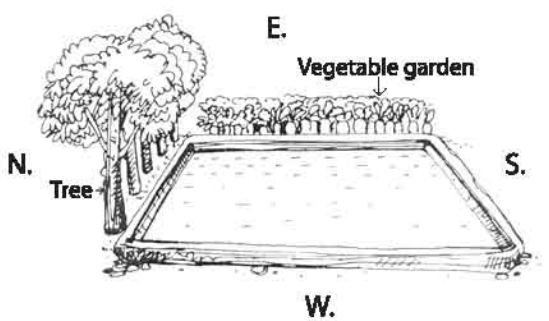


Fig: 1.

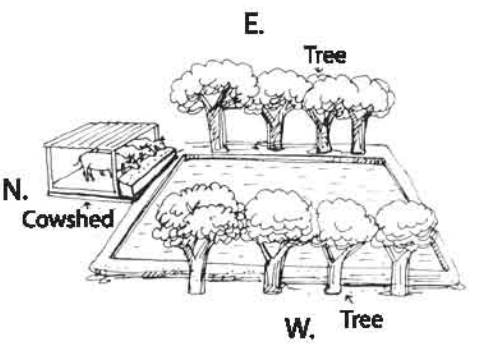


Fig: 2.

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a) What is mixed culture?

b) Explain one advantage of mixed culture of fish.

c) Which one pond in the picture above is suitable for mixed culture of fish, explain the causes.

d) Whether the two ponds of the picture are equally profitable? Show points in favour of your answer.

2. Mr. Amal established one dairy farm with 5 crossbreed cows after taking training from youth development programme. He was not getting expected milk after taking sufficient care of the cows. In this situation he took the advice of Livestock Officer on healthy rearing methods and implemented it. After that each cow is now giving 12 liter milk every day. Now he is a successful dairy farmer.

a) Which breed of cow did eat more feed?

b) Why is the cowshed to be made on high land? Explain.

c) Calculate how much concentrated feed is required for each cow of Mr. Amal per day?

d) What were the steps that Mr. Amal took for which milk production of his cows reached the expected level? Make an analysis.

Chapter Six

Forestry

Agro forestry is an old and traditional land use system. In recent years this system has been introduced known as agricultural science and agricultural technology. Agro forestry is a combined production system of agricultural crops and forest trees, where a farmer can get higher production and can be benefitted by using land properly. This forestry system is also environment friendly. It is obligatory to increase forestry productions in planned way in the whole country. For this we need to have enough knowledge and skill about agriculture and social forestry. We need to be aware of the importance of this type of forestry. We need to increase forestry by direct participation of this forestation to keep the environment sustainable for livings. In this chapter you learn the techniques of nursery preparation and its contribution, thus you will be skilled in this matter. Above all, you will be able to understand the importance and problems of agriculture and social forestry and will find out the ways to solve them. You can also prepare the social forestry and agro forestry model; can plant trees in the sides of roads and embankments.

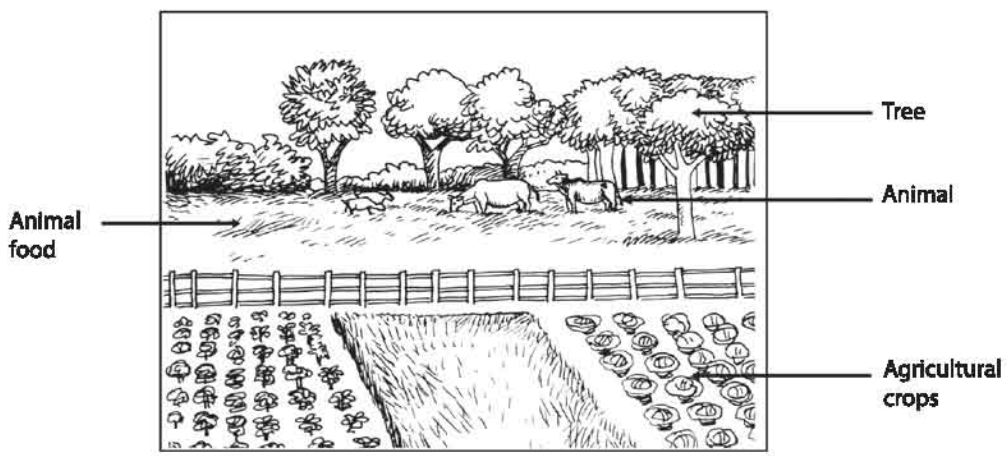


Fig: Agro forestry

After reading this Lesson we can-

- explain the techniques of nursery preparation in the field of agriculture.
- prepare the seedlings in the poly bag.
- explain the importance of agro forestry.
- explain to solve the problems of agro forestry.

- draw the model of social forestry and agro forestry.
- describe the model of social forestry and agro forestry.
- explain the necessity of mixed tree plantation.
- describe the methods of tree plantation in the edge of roads and embankments.

Lesson 1: Nursery and nursery in the agriculture

Nursery is a centre of seedling production where seedlings are produced and taken care of until transplantation in the main field. You need practical experience and efficiency about nursery. For this visit a nursery with your teacher in available time. Watch video of nursery in your classroom. If video of nursery is not available, observe nursery picture in the chart. Answer the questions asked by your teacher about nursery.

Fig: Permanent nursery

The forests' resources are in the risk and getting destroyed in order to fulfill the demand of ever increasing population. For reson the environment is going out of habitation. To escape from this danger effect of increasing population, we need to protect trees and start afforestation. We need healthy seedlings for any kind of afforestation. For this we need to rely on nursery.

Types of nursery

1. Depending on constancy nursery can be divided in two types, like-
   (a) Permanent nursery (b) Temporary nursery

A. Permanent nursery: The nursery where seedlings are produced year after year is called permanent nursery. The communication facility of this nursery is well. Permanent nurseries have in both government and non-government sectors. Many kinds of improved seedlings are distributed from permanent nursery every year.

B. Temporary nursery: Department of Roads and Highways transplant seedlings of different trees in both sides of new roads. For this they established temporary nursery. Where woodlots or massive afforestation is being raised, temporary nursery is constructing there which reduce the transport cost of seedlings. Healthy and vigorous seedling can be produced easily.

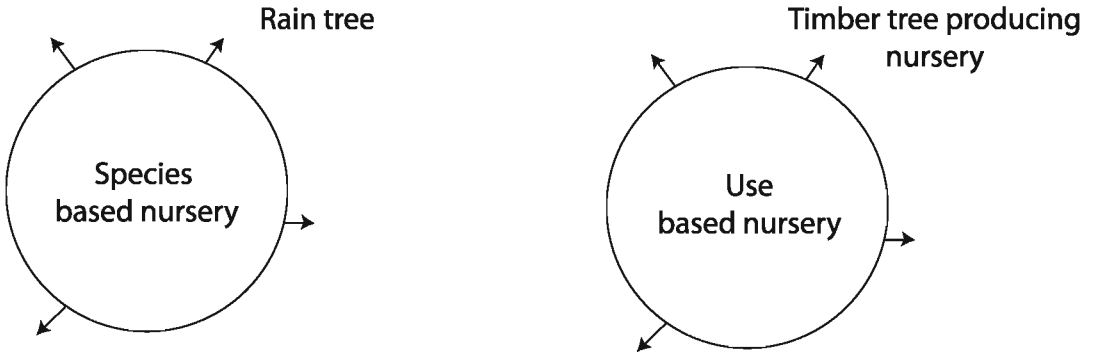
2. Depending on medium, in terms of medium, there are two types of nursery.

a) Polybag nursery, b) Bed nursery

A. Polybag nursery: Seedlings of different plants which are grown and taken care of in the polybag is called polybag nursery. Polybag seedlings can be transported easily in the safe place. As a result they may remain unaffected at the time of natural calamity.

B. Bed nursery: When seeds are directly sown in the seed bed of nursery and are produced seedlings is called bed nursery. Sometimes, seeds are sown in the nursery bed and need to shift in the polybag after germination. Some other nurseries are: home based nursery, species based nursery and usage based nursery.

Work-1: Complete the nursery related following maps in two poster papers in groups.



Necessity of nursery in the field of agriculture

1. Healthy, vigorous and different age-group seedlings are found in the nursery for transplantation.
2. It is easy to take care of seedling in the nursery.
3. Nursery is the best place for seedling production of the species of garjan, telsur, shal trees, because, the seeds of these timber trees are to be kept in germination within 24 hours after collection.
4. It is necessary to germinate seeds of jack-fruit, champa etc. immediately after collection of seeds from fruit; otherwise, the germination percentage of these seeds will be drastically reduced. Nursery is necessary to produce seedlings of these trees.
5. Nursery is the appropriate place for production of seedlings with less labour and capital.
6. Distribution and marketing of seedlings are easier from here.

Work-2: Discuss in groups and list down the importance of nursery.

Lesson 2: Techniques of preparation of nursery

Proper planning is the first step for the preparation of nursery. This planning should be done based on some rules and characteristics. For the

establishment of a permanent nursery, the following points should be kept in mind:

1. Site selection
2. Measurement of site
3. Fencing
4. Land development
5. Office and living space
6. Electrification
7. Roads and paths
8. Management of irrigation
9. Management of drainage
10. Nursery block
11. Nursery bed
12. Visitors path

The soils of the selected nursery site should be fertile and sandy-loam. The nursery place should be in high, leveled with proper sunlight and aeration. There must have well managed Irrigation. Good communication facility must be available for goods and seedling transportation.

The following number of scedlings to be transplanted in one square meter (10.75 sq.ft) shed bed or pot bed–

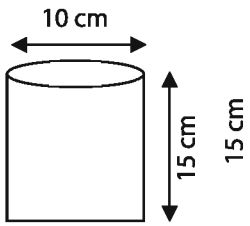


Fig: Polybag

Size of the polybag	Number of seedling per polybag
15 cm x 10 cm	65
18 cm x 12 cm	45
25 cm x 15 cm	26

Distance of seedlings in seed bed	Number of seedlings per square meter (10.75 ft^2)
5 x 10 cm	400
10 x 12 cm	200
10 x 10 cm	100

Nursery block, bed and visitor's road

Divide the area of nursery into some blocks where seedlings are to be produced. Prepare some beds into east-west direction in each block. Keep 25 cm area in between two beds. Keep visitors and sub-visitors road as possible in different blocks. The main visitor's road should be 2-3 m and sub-visitor's road should be

1-2 m wide. The main visitor's road should be made in such way that the vehicles might run easily. It is kept in mind that the seedling trolleys might move easily along the sub-visitor's road.

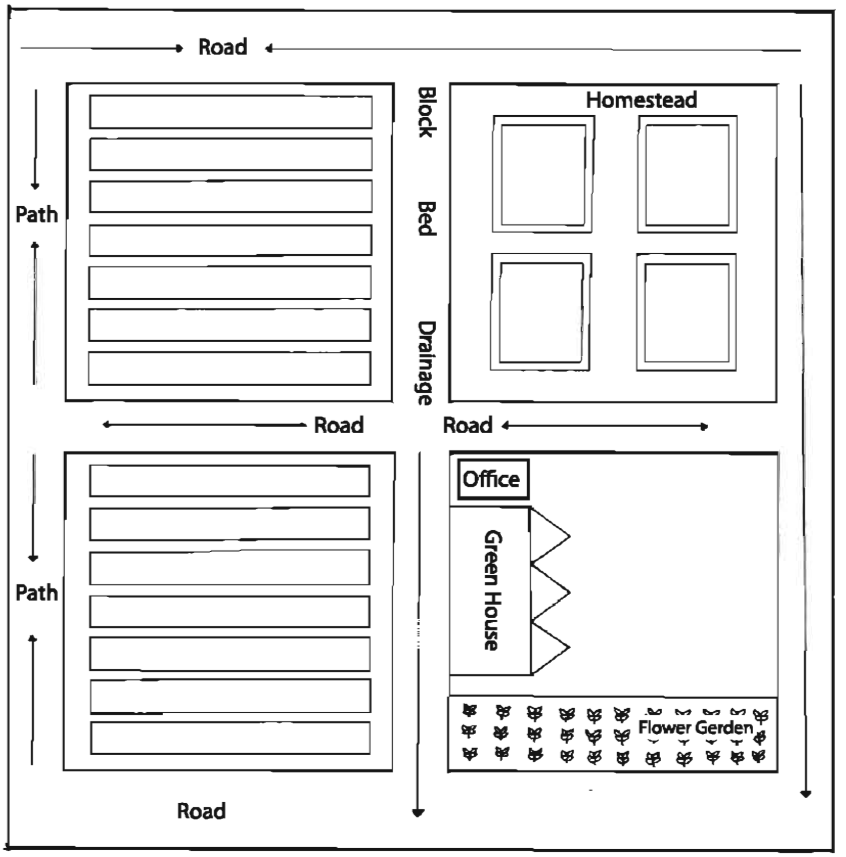


Fig: Planning of nursery (Model)

Work: Draw a permanent nursery plan in poster paper in groups and present in the classroom.

Lesson 3: Prepare seedlings in polybag

Procedure of classroom group preparation and direction of seed sowing into polybag by hand and preparation of seedling

1. Divide students into possible different groups and select group leader.

2. Each group leader should collect necessary supplies for preparation of seedlings.
3. Fill up a polybag by each group with soil mixtures following the recommended procedure.
4. Sow seed into polybag and observe.
5. Ask the teacher about the date of submission of the group report of seedling preparation procedure.
6. Complete this part of reading in the field.

Subject: Seed sowing in the poly bag and preparation of seedling

Materials: Seed, loam soil, cow dung, compost, poly bag measuring 15 cm x 10 cm, watering cane.

Working procedure:

1. Crush the soils.
2. Mix 3/4 of soils with 1/4 cow dung or compost together.
3. Prepare eight holes in two rows including one at lower side of poly bag.
4. Pour soils gently into poly bag.
5. Arrange the poly bags under shady and plain place.
6. Prepare two holes on the top of the soils in polybag using finger. Put one seed in each hole.
7. Cover the seeds with fine soils. Spray water lightly with watering cane.
8. Write down the date of seed sowing on the practical note book.
9. Give water into polybag using watering cane everyday morning and afternoon.
10. Write down the date of germination in the note book.
11. Observe the seedling up to 15 cm long.
12. Write all the reports of this experiment in your practical note book. Prepare working procedure and submit it to the teacher.

Pictures of procedures of seedling preparation in poly bag.

Fig: Sieving of soil particle for polybag

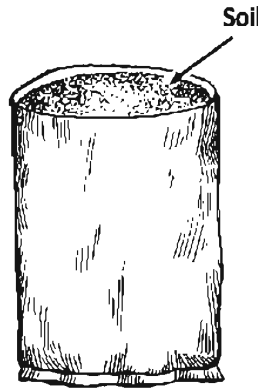


Fig: Filling soil in polybag

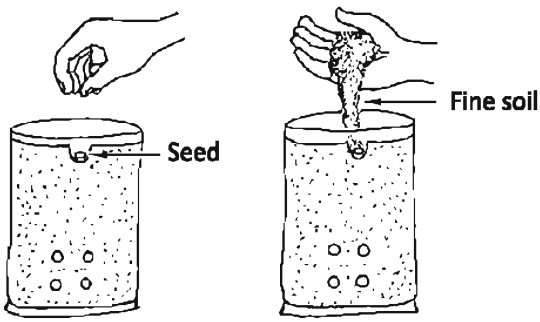


Fig: Sowing seed in polybag

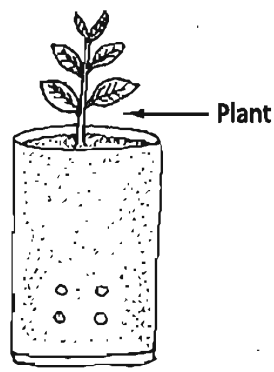


Fig: Plant implantation in polybag

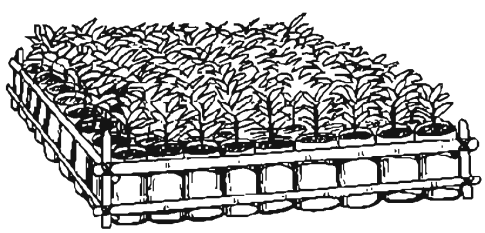


Fig: Method of arrangement of Polybag in the bed of nursery

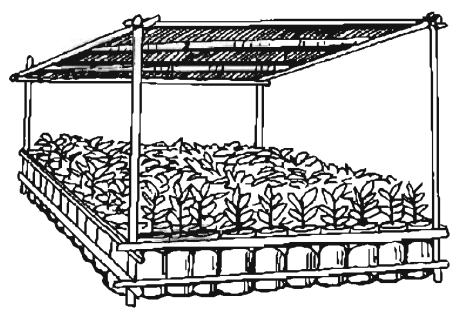


Fig: Bamboo shed over the poly bag bed of nursery

Work: Students will carefully observe the procedure of seedling preparation in polybags and describe the procedure of filling soil in polybags and sowing seeds.

Lesson 4: Importance of agro forestry

Agro forestry is one sort of land production management system. In this system, Afforestation is managed in a planned way. Trees, crops, livestock's and fishes are grown sequentially by this system in the same land. One component of this system may create limited or no pressure on the performance of other components. All the components collectively enrich the environment. This type of forestry is economically profitable. For this afforestation, land can be used in a diversified way.

Work:

(1) Observe the picture supplied by teacher and say why it is called agro forestry?

(2) Discuss in groups and say why agro forestry is important.

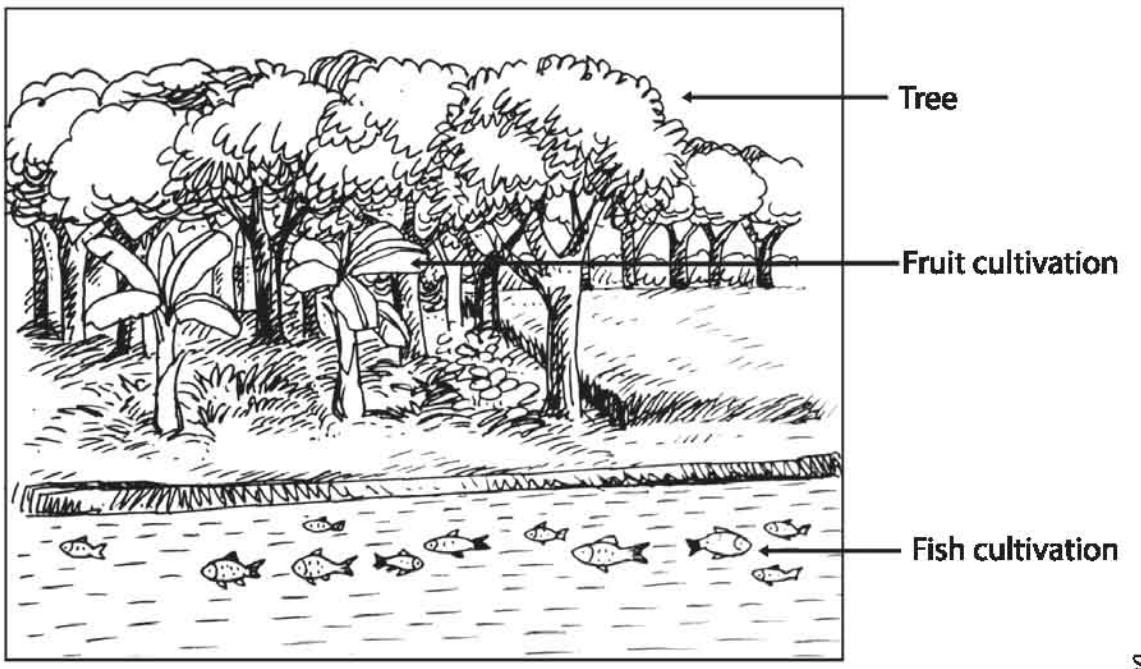


Fig: Model of combined production system of trees, crops and fishes.

Ever increasing population is a great problem in our national life. Our land is limited. This limited land is not capable of meeting the demand of this huge population. So, the afforestation will not be limited only to forest areas. It is a demand of time to accept the agro forestry as modern production technology. Agro forestry is necessary to expand in farmland, edges of roads and embankments, in and around homesteads and institutional premises. For this a revolution of sustainable and massive agro forestry system should necessarily be taken place around the country.

Agro forestry can play an important role to meet up diversified problem in our life. Check out the following subjects with your own list and discuss –

Importance of agro forestry

1. Agro forestry can help to resolve the demand of food.
2. It facilitates for making house material and furniture.
3. It solves the fuel wood crisis.
4. It helps to cultivate different crops and trees in the same land.
5. Increase income and employment opportunity and reduce poverty.
6. Local material can be used.
7. Reduce soil erosion and improve soil fertility.
8. Environment becomes suitable for living for the living creatures.
9. Protect from natural calamity.
10. Create food and habitat for animals and birds.
11. Maximize the rainfall.
12. Protect from drought, flood and land slides.

Above all, agro forestry can begin the revolutionary change in the production system and economic growth of rural community.

Lesson 5: Problems of agro forestry and its solution :

Agro forestry is a land use system, where-

1. Trees are deliberately grown with crops and/or animals in a same land management unit.
2. Herbaceous crops are grown together with trees.
3. Improved production and assistance can be obtained from agro forestry rather than sole agriculture and forest.

Work -1: Problems of agro forestry and solution.

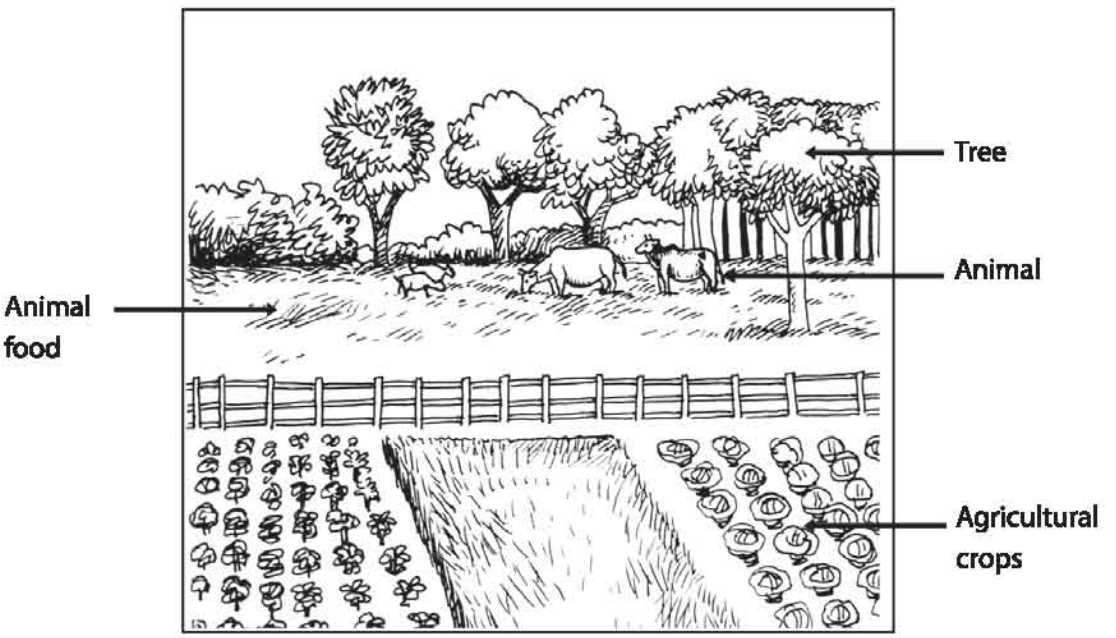


Fig: Agro forestry

Problem of agro forestry

Agro forestry is known to be a profitable technology all over the world in the recent years. But there are some problems in agro forestry too. Now check the

following problems and solutions of agro forestry with your opened list-

1. The necessary land for agro forestry has been reducing.
2. The fertility of land is decreasing because of the use of chemical fertilizer and pesticide.
3. The production is diminised by the attack of insect-pest.
4. Lack of quality seed and fertilizer .
5. Problem with maintenance of agro forestry.
6. Lack of irrigation during the dry season.
7. Lack of preservation facilities of productive goods.
8. Products cannot be supplied properly due to weak communication system. So, the products are perished and the farmers become bound to sell their products at a cheaper rate.
9. Lack of experience and efficiency of farmer about agro forestry.
10. Lack of agro-based industry.
11. Lack of preservation facilities of agricultural products for rural area.

Solving the problems of agro forestry

Our land is limited. It is now time to demand to accept the agro forestry as modern production technology. To expand the cultivable land where Social forestry is being introduced, this land needed to be brought under agro forestry. The farmers have to follow the crop rotation system and increase the use of organic fertilizer. So that the fertility of the land can be improved. By using light trap, handmade trap, neem etc. control the harmful pest. If the production is damaged by natural disaster the Government will take responsibilities to minimize the loss of farmer steps should be taken so that the farmers get the actual price of their products. The Government has to take necessary step to train up the farmers about agro forestry. The communication system should be developed all over the country besides, sufficient number of cold storages have to be established to preserve the agro products.

Sufficient numbers of cold storages have to be established by the Government and Non-Government organization, to preserve the agro product instantly. The Government, Non-Government organization, N G 0, concern authority should take necessary steps to solve the problem of agro forestry by this system.

Work: Observe carefully the model of agro forestry. Express your own opinion about different aspects of agro forestry. Have you witnessed agro forestry practically? Tell about the characteristics of agro forestry if you have seen. Why is agro forestry profitable? Prepare a list of some obstacles of agro forestry in our country. Discuss in groups and find out the solutions to the problems.

Lesson 6: Description of the model of social aforestation

Social forest

The people of a community create this forestry with their own attempt for making environmental-friendly atmosphere. This type of forestry can be created in the fallow lands of homesteads, institutions, roads and embankments, coastal areas, hilly areas etc.

Model of social forestry in roads and embankments

In Bangladesh, one or two row model of tree plantation are observed on the sides of roads and embankments. The number of rows depend on the slopes of roads and embankments.

One-row model

If the roads are narrow, trees are planted in the road side. In this system, same distance is maintained between trees the road side following this model when the roads are narrow. Same distance is maintained between trees.

Two-row model

This model is followed if the sides of the road and embankment are spacious. It is mandatory to follow accurate model.

Plantation of trees at the edges of road

Techniques of tree plantation: There are inadequate spaces at the edges of road. So, trees are planted following narrow line. Trees are planted maintaining 2m x 2m distance at hilly areas in afforestation program.

Points to be considered during selection of trees

Trees containing little and narrow leaves are to be planted at the edges of road and embankment. Multilayered agro forestry model is good for roadside plantation. For this a shrub layer of different plants are necessary under the tree. Otherwise medium or bush shaped trees are necessary to select.

Techniques of tree plantation

1. One row of tree is planted by the side of road which is restricted for pedestrians walk. Sometimes more than one row of trees might be planted depending on place and availability of land. If two rows of trees are planted, the distance from tree to tree will be 1.5-2.5 m.
2. Trees are planted in line on the slopes of embankment. The second row will start from a place when in the middle of two plants of the first row maintains the same distance between trees in first row.
3. One row of trees can be planted at the downward of road. At the end of slope of roads, mander, jarul, hijol etc. trees can be planted.
4. The second row of plants will start from the middle position between first two plant of the first row. So, if the plants are planted keeping two meter of distance, the actual distance of the plants will be 2 meter 1 meter. Resultantly, the soil will be more resistant to erosion and the embankment will not collapse.

Tree selection

1. It is not wise to plant dicotyledonous and heavy branched trees at both the sides of embankment. Because if the trees are high enough, it may breakdown by heavy wind flow and may increase soil erosion beneath the tree.

2. It is wise to select trees which spread its root around vast areas. Examples of monocotyledonous trees are coconut, betelnut etc. By spreading roots, these trees reduce soil erosion.

3. The trees which are used for fodder purpose are to be selected for plantation at the sides of embankment. Because these embankments might be used for the shelter of domestic animals at the time of severe flood.

Lesson 7: Description of tree plantation method in roadsides and embankments

Line afforestation method

In this method generally one, two or three rows of trees are planted in the edges of road and embankment sides. This method is called line afforestation method. Line afforestation or strip afforestation is an important production technology of social forestry. Sissoo, akashmoni, arjun, mehogony, jarul, siris, rain tree, sonalu, krishnachura, neem etc. trees are planted in line afforestation method. Other than Forest Department, different NGOs are creating line afforestation in the vast areas of the country with the help of the programme of FAO and by their own activities. The programmes of line afforestation in the name of Thana afforestation and Nursery Development project are on have been going on with the participation of local people since 1990. The three traditional line afforestation methods are:

Model-1. Afforestation in the big roads, railways and embankments

Model-2. Afforestation in the approach roads and village roads

Model-3. Afforestation in the highways and high railways

Description of Model-1

1. The line of Arhar plant will be below 30 cm away from the edge of roadside/embankment.
2. The first line of tree seedlings will be planted 30 cm away from arhar line at downward slope where seedling distance will be 2 m.
3. The second line of tree seedlings will be 1.5-2.5 m away from first line (depending on width of slope) where seedling distance will be 2 m.
4. At the end of the slope of roads/embankment, more than one rows of dhaincha will be sown.
5. If the width of slope of roads/embankment is more than 3 m, tree seedlings are planted maintaining three or more rows.
6. A hole of measuring 30 cm x 30 cm x 30 cm will be dug. In each whole 1 kg of cowdung, 25 gm of TSP and 25 gm of MOP will be incorporated with the soil.
7. In total 1600 seedlings are planted in one kilometer length road under this model.

Selection of species

In the first line, decorative, shadowy and timber tree seedlings like-mehogony, raintree, sissoo, segun, mango, jack-fruit, date palm, palmyra palm etc. should be planted. First growing fuel and pole tree seedlings, for example- akashmoni, arjun, babla, sissoo, ipil-ipil, raintree etc. need to plant in the second line.

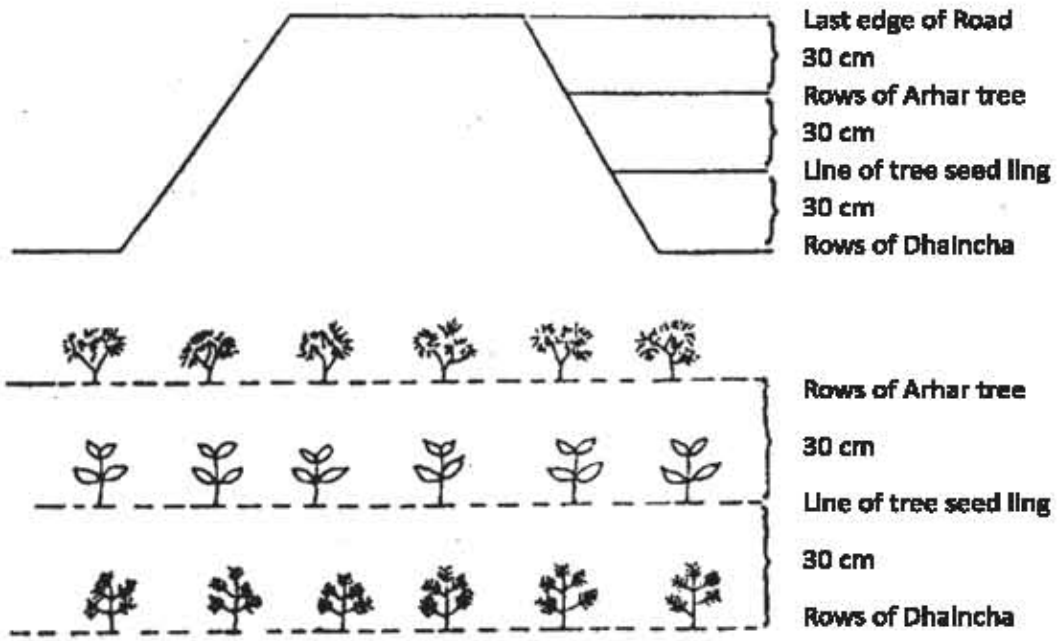


Fig: Model of one row tree plantation in the edges of roadsides/embankments.

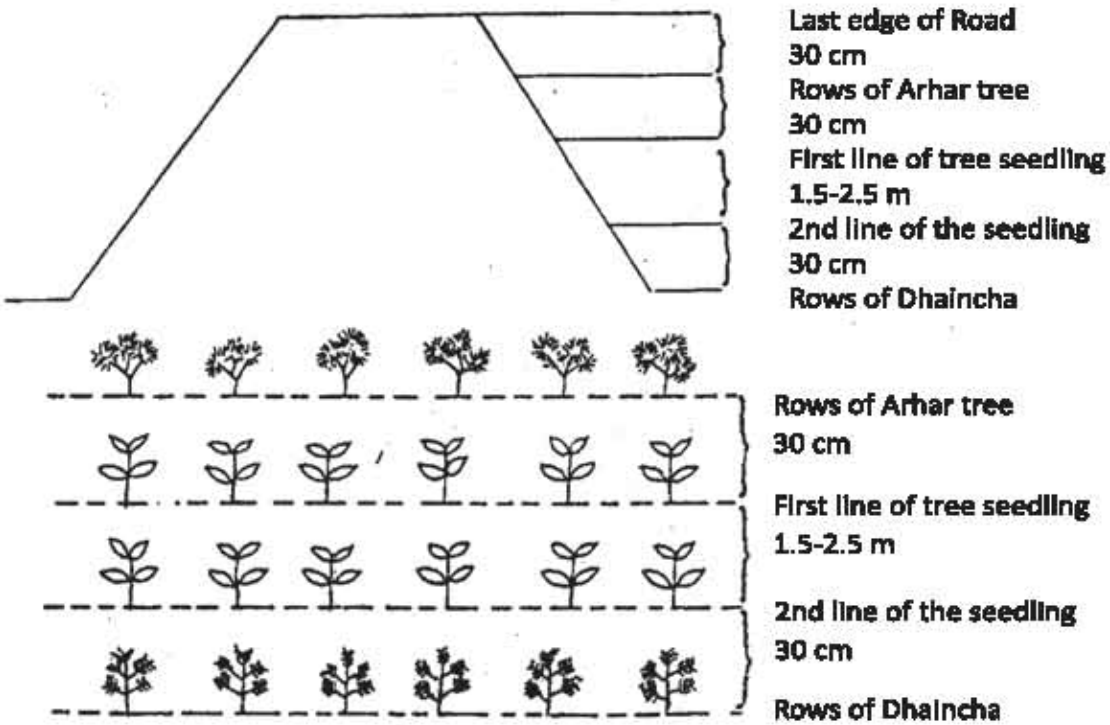


Fig: Model of two row tree plantation method in the edges of roads/embankments.

Work: Draw a two row model of roads/embankments afforestation in groups on the poster paper and present.

Lesson 8: Tree plantation in the roads/embankments or school premises.

Site selection:

The edges of roads and embankments or premises of schools and its surrounding places

Necessary materials:

1. Spade, khunti, shabol, knife, cowdung, chemical fertilizers etc.
2. Practical note book, pencil, pen, rubber, eraser, scale etc.

Working procedure:

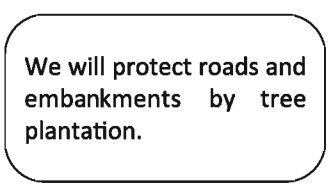
1. If the afforestation area is the premises of school, prune the branches of big trees near the planting places. No need to cut branches of trees if the places are near the road/embankment side.
2. Collect the vigorous seedlings of selected trees.
3. Dug a hole maintaining appropriate measurement.
4. Mix cowdung and chemical fertilizer with the soils in a hole and left it 15 days by the side of hole.
5. Put the mixed soils into the hole again.
6. Dug a hole measuring the area of mud bole containing seedling.

7. Remove the polythene from mud bole with knife.
8. Place the mud bole of seedling into the hole, put soils and press it until it becomes compact.
9. Now pour water to the hole.
10. Write down the whole procedure in your practical note book. Bring it to your teacher and take signature.

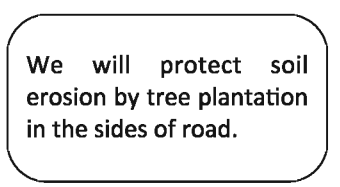
Importance of tree plantation in road and embankment sides

1. Protect the roads and embankments from soil erosion.
2. Produce animal food.
3. Greening of roads and embankment sides.
4. Increase national production and income.
5. Create employment opportunities.
6. Make habitat for birds and insects.
7. Keep the environment cool and create favorable weather for rain.
8. Conserve the environment.

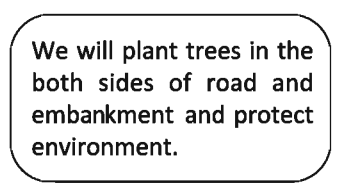
Work: Make poster paper in groups mentioning the necessity of afforestation in the roads and embankment sides and demonstrate it in the class.



Model poster-1



Model poster-2



Model poster-3

Lesson 9: Preparation of agro forestry model and its description

Agro forestry is a system where trees, crops and livestock's are deliberately grown in a same piece of land. This system does not hamper the production

of other components. It has no harmful effect on environment. This system is economically profitable. There are many possible scopes of agro forestry in Bangladesh. These are - homesteads, fallow lands around homesteads, crop lands, fallow and marginal lands, eroded and newly afforested lands, road, railway, and embankments sides, banks of ponds and small waterways and coastal areas.

Points to be considered during preparation of agro forestry models/pictures for the selected areas in a local community:

1. Status of land
2. Social and economic conditions
3. Characteristics of soil
4. Demand of farmers

Description of some prospective agro forestry model/pictures:

1. **Trees and crops cultivation in agricultural land:** Agricultural crops are grown with trees sequentially in a same piece of land.

   A. Trees are planted maintaining specific rows comparatively in low land and agricultural crops are grown in between vacant spaces of rows of trees.

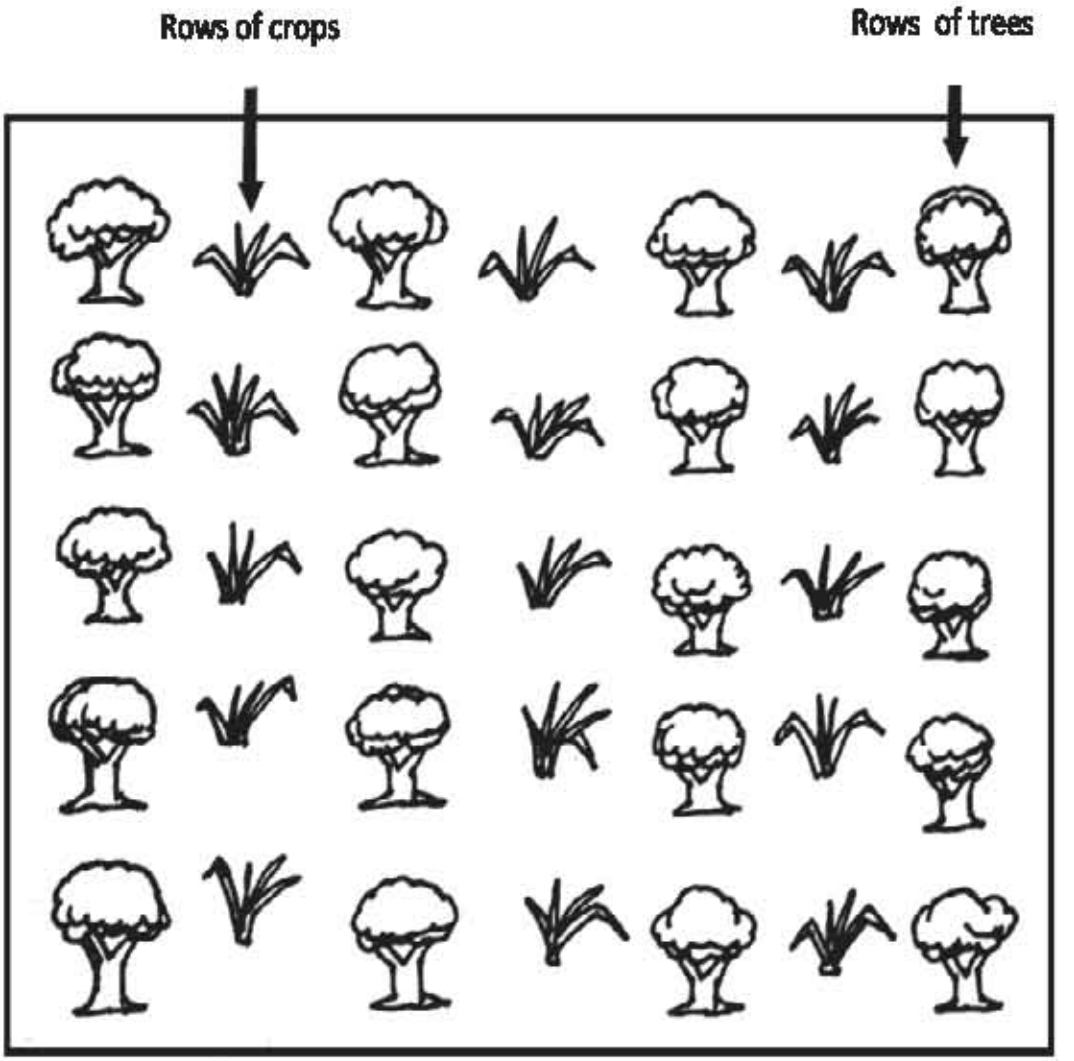


Fig: Agro forestry of row plantation in the crop land

B. Trees are planted making rows around the agricultural crops near ails.

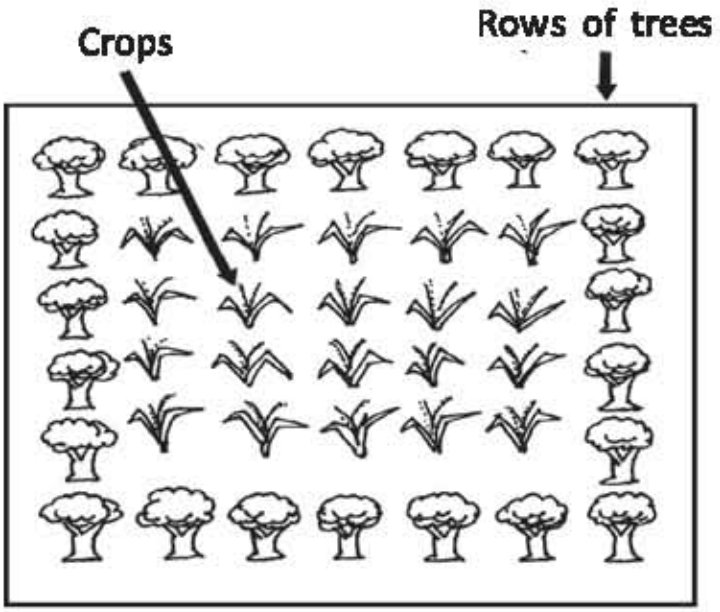


Fig: Boundary plantation in the crop field

C. In this model, farmers plant trees in the crop field in a haphazard manner.

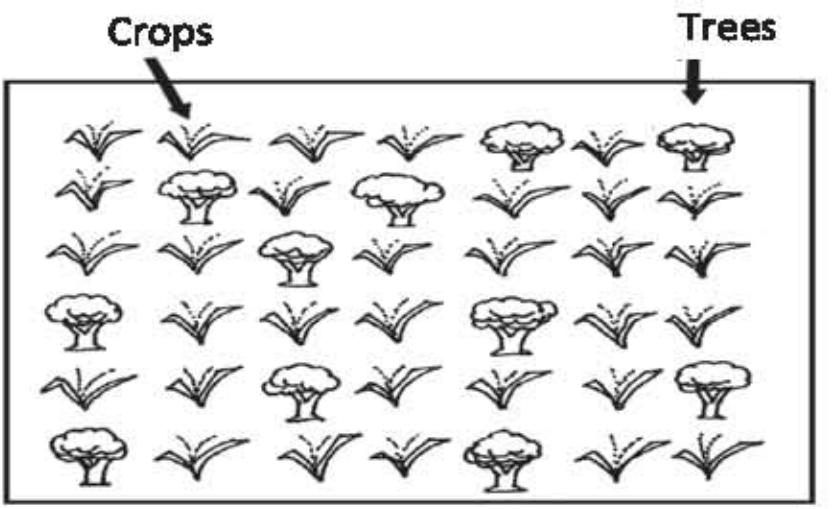


Fig: Scattered plantation in the crop field

2. Alley cropping: Alley cropping is a promising production system among various agroforestry models. In this system, crops are grown between hedge rows of planted legume trees or shrubs at a certain distance.

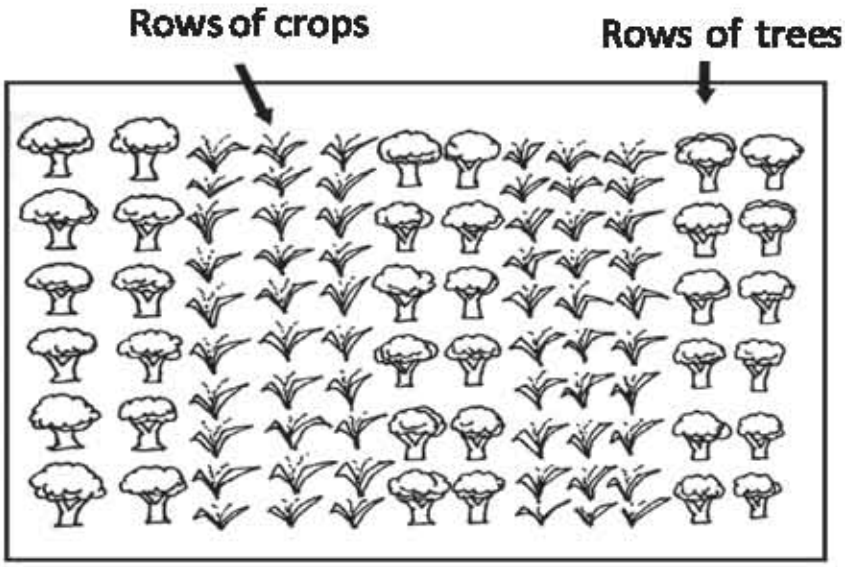


Fig: Alley cropping

3. Crops, trees and livestock's (Agro silvopasture): In this system, crops are grown in a same piece of land with trees and animals.

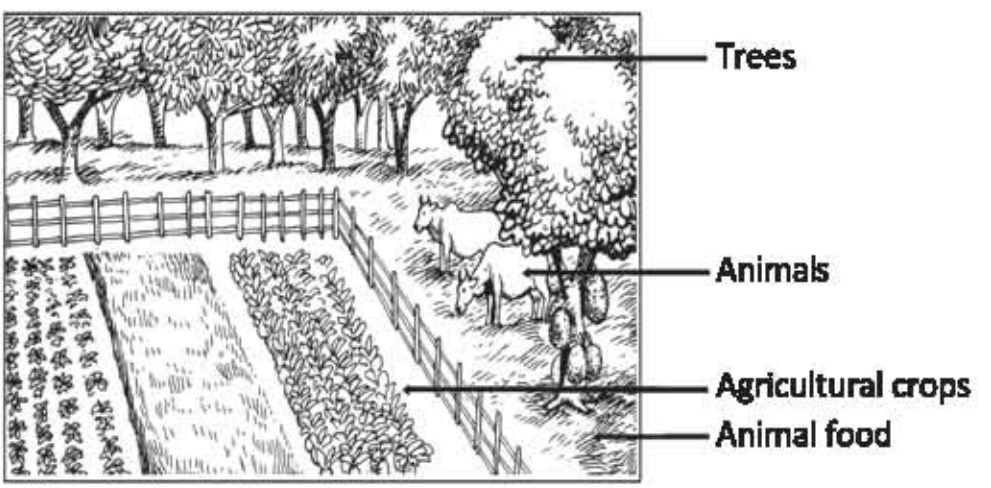


Fig: Agro silvopastoral system

4. Fisheries, trees and crops (Aqua-horticulture): In this system, vine type vegetables are grown on the scaffold at the slope of ponds along with fishery. Aquatic plants are cultivated at the edges of water and fruit trees are planted at the banks of ponds.

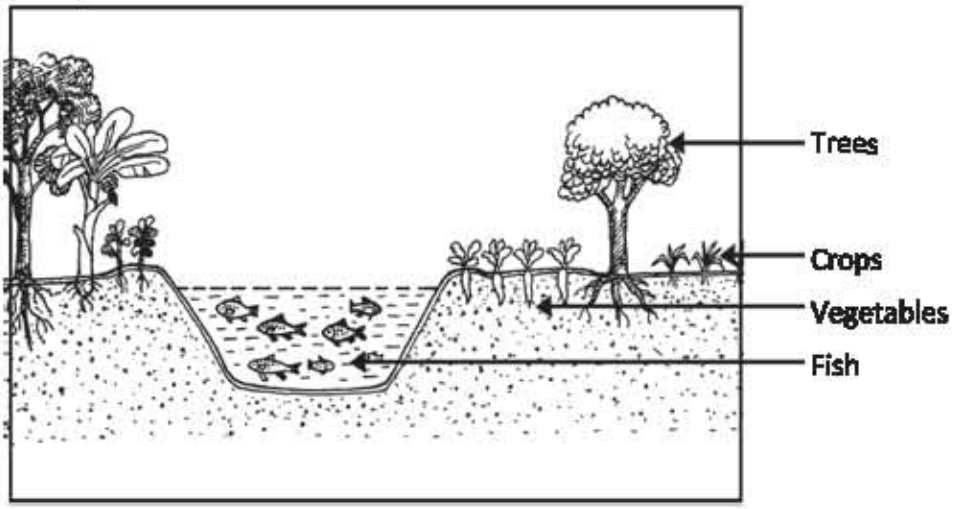


Fig: Aquahorticultural system

5. Homestead agroforestry: It is a unique example of agrosilvopastoral system where different shade loving and shade tolerant vegetables, other food crops are grown along with livestock, poultry as well as various species of fruit, fuel, fodder and timber trees.

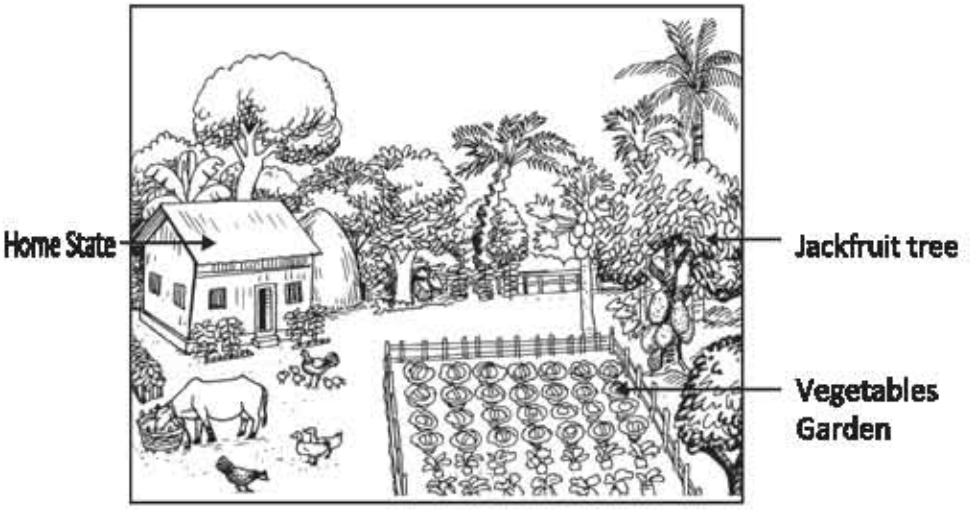


Fig: Homestead agroforestry

Work: Draw a model in groups of agroforestry system in the poster paper that is possible to implement in your locality and present.

Lesson 10: Necessity of mixed-tree plantation

Cultivation of mixed-tree

Cultivation of mixed-tree is one kind of agro forestry system. Under this afforestation method, various types of trees are grown together. Many kinds of fruit trees, forest trees and medicinal plants are grown combinely in a same piece of land in this system. Sometimes, a variety of agricultural crops are grown together with these trees. Livestock's and fishes are also cultivated with mixed-tree plantation. Mixed-trees are possible to cultivate in and around homesteads, boundary of playground, premises of schools and other institutions, in the crop fields, banks of river, bills, ponds etc.

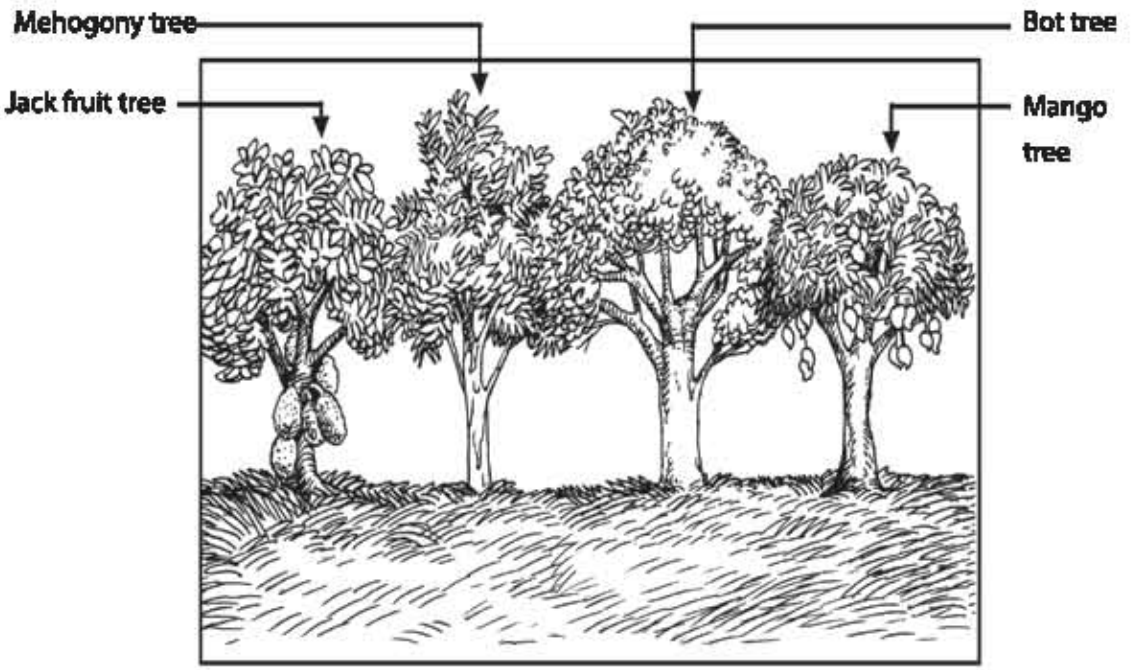


Fig: Mixed-tree plantation

Selection of locality of mixed-tree plantation

Medium low and low land

The trees which can tolerate flood water periodically or can tolerate stagnant water can be planted in the low land. Examples of these trees are- hijol, raina, jarul, mander, koroch etc. This type of trees can be planted in the haors, bills and their adjacent low lying areas.

Medium high and high land

Medium high and high land areas are suitable for cultivation of different types of trees. Mixed-tree cultivation is possible in this area with various kinds of trees including mango, jack-fruit, palmyra palm, date palm, mehogony, shal, segun, bel, tamarind, amloki, horitoki, bohera, etc. These trees are cultivated in the greater district of Dhaka, Mymensingh, Rajshahi, Rangpur. Different kinds of crops like-cotton, pineapple, orange, banana etc. are cultivated in the vacant spaces of mixed-tree plantation.

Work: Prepare an answer script of the following two questions about mixed-tree cultivation by group discussion and present.

1. Make a list of the names of mixed-trees in the poster paper that are cultivated in your locality.
2. Mention the disadvantages of sole forest tree cultivation instead of mixed-tree in your locality.

Necessity of mixed-tree cultivation

1. It helps identify various tree species under different localities.
2. The demands of the local people can be meet up by mixed-tree cultivation.

3. It improves livelihood standard by increasing income.
4. It improves biodiversity of the locality by creating habitat of animas, birds and other faunas.
5. It creates environmental stability in the locality.
6. It generates employment opportunity, increase income and reduce poverty.
7. Mixed-tree plantation must play vital role for meeting up demand of fuel, nutrition, food, cloth and shelter etc.
8. It keeps the environment cool and increases rain environment and increase rain.
9. it protects lives and wealth from adverse natural climate like-flood, cyclone, drought, tidal surge and reduce soil erosion.

Work: Complete the following table about mixed-tree plantation.

Food producing trees	Cloth producing trees	House construction material producing trees	Furniture producing trees	Medicinal plants
1.	1.	1.	1.	1.
2.	2.	2.	2.	2.

Exercise

Multiple questions

1. Which plants are to be planted at 30 cm away from the edge of embankment?

   a. Arhar
   b. Tree
   c. Crop
   d. Dhaincha

2. The problems of agro forestry-

   i. unwilling of peoples participation

   ii. lack of necessary lands

   iii. lack of expert coach

Which is correct in the followings?

a. i and ii
b. i and iii
c. ii and iii
d. i, ii and iii

Read the following passage and answer 3 and 4 no. questions of the following:

Supti Rani works in a NGO. She was assigned to to plant trees in two kilometers long village pakka road. She planned to transplant broad leaved trees along with other trees.

3. How many segun tree seedlings are needed for Supti Rani?

a. 800
b. 1600
c. 2400
d. 3200

4. How will the planning of Supti Rani create pressure on the other trees?

a. increase photosynthesis of other trees
b. retard growth of little trees
c. reduce crop production of the land
d. restrict growth of soil microorganism

Creative questions:

1. The homestead area of Haripad Sarker is one acre. There is a pond and some raised follow lands in his home yard. But he does not have agricultural lands. He faces problem in educating his children as well as to meet up family expenses. However, he has taken initiatives for increasing production buying two cows and a variety of seedlings.

   a. What is agro forestry?

   b. Explain the necessity of mixed-tree plantation.

   c. Describe the agro forestry model based on the homeyard of Haripad Sarker.

   d. Analyse the activities of Haripad Sarker for the improvement of his economic conditions.

2. There is a big canal running by the side of Barisal High School. Head teacher took initiative for social forestry programme in the school premises near the bank of the canal. The students of this school succeeded in planting various tree species following appropriate rule. They arranged a rally making various posters containing self-motivated slogans about social forestry.

   a. What is nursery?

   b. How does tree cool environment? Explain.

   c. Explain the techniques of student's success.

   d. Evaluate the students' activities of self- awareness for the people of locality.

Short answer questions

1. What do you mean by polybag nursery?
2. What is agro forestry?
3. Write down the steps of tree plantation in the roads and embankment sides.

Descriptive questions

1. Write down the importance of agroforestry.
2. Write down the steps of making seedlings in the polybag.
3. Describe the techniques of tree plantation in the roads and embankment sides.
4. Mention the necessity of mixed-tree cultivation.

The End

2020

Academic Year

8-Agriculture

বঙ্গবন্ধুর স্বপ্ন– দারিদ্র্য ও নিরক্ষরতামুক্ত সোনার বাংলাদেশ গড়তে
নিজেদের যোগ্য নাগরিক হিসেবে গড়ে তোল

– মাননীয় প্রধানমন্ত্রী শেখ হাসিনা

সুন্দর আচরণই পুণ্য

তথ্য, সেবা ও সামাজিক সমস্যা প্রতিকারের জন্য '৩৩৩' কলসেন্টারে ফোন করুন

নারী ও শিশু নির্যাতনের ঘটনা ঘটলে প্রতিকার ও প্রতিরোধের জন্য ন্যাশনাল হেল্পলাইন সেন্টারে ১০৯ নম্বর-এ (টোল ফ্রি, ২৪ ঘণ্টা সার্ভিস) ফোন করুন

Ministry of Education

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