

Agriculture Studies

Classes 9-10



NATIONAL CURRICULUM & TEXTBOOK BOARD, DHAKA

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Agriculture Studies

Class Nine-Ten

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PREFACE

Education is the pre-requisite for the holistic development in our national life. To cope with the challenges of the fast changing world and to lead Bangladesh to the doorstep of development and prosperity, a well educated and skilled population is needed. In order to build up a nation imbued with the spirit of the Language Movement and our Liberation War, the secondary education aims at flourishing the talents and prospects inherent in the learners. Besides, the other aims also include expansion and consolidation of the basic knowledge and skills of the learners acquired at the primary level in order to make them fit for entry into higher education.

The aims of secondary education further emphasise on developing these learners as skilled and competent citizens of the country through the process of acquiring knowledge at the backdrop of socio-economic, cultural and environmental settings.

Keeping the aims and objectives of National Education Policy 2010 ahead, the curriculum at the secondary level has been revised. In the revised curriculum the national aims, objectives and contemporary needs have been reflected. Along with these expected learning outcomes have been determined based on the learner's age, merit and level of acquisition. Besides, efforts have been made to raise, starting from the level of moral and humanistic values down to awareness on history and tradition, the spirit of the Liberation War, passion for art-culture and literature, patriotism, feelings for nature and equal dignity to all irrespective of religions, caste, creed and sex. Efforts have also been made to apply science in all spheres of our life in order to build a nation advanced in science. Attempts are also there to make the learner capable of implementing the goals envisioned in Digital Bangladesh-2021.

In the light of the present curriculum almost all the textbooks at the secondary level have been introduced. While introducing the textbooks, the capacity, aptitude and prior knowledge of the learners have been taken into utmost consideration. While selecting the contexts and their presentation special attention has been given on the expansion of the learner's creative faculty. Adding learning outcomes at the beginning of each chapter, hints about the achievable knowledge of the learners have been given. By adding variety of activities, creative and other questions evaluation has also been made creative.

Bangladesh is basically an agro based country. Keeping the challenge of 21st century ahead in mind this textbook has been produced to introduce with 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.

Considering the challenges and commitments of 21st century and following the revised curriculum the textbook has been written. Therefore we welcome with our highest consideration any suggestions, both constructive and rationale as well for the further improvement of the book. Amidst huge activities needed for introducing a textbook, this one has been written within a very short span of time frame. We will continue our effort to make the next edition of this book more beautiful, decent and free from any types of errors.

We appreciate the endeavours of those who assisted very sincerely with their merit and hard work in the process of writing, translating, editing, illustration, introducing sample questions and printing of the book. We hope the book will ensure joyful reading and achievement of expected skills from the learners.

Prof. Md. Mostafa Kamaluddin

Chairman

National Curriculum and Textbook Board, Dhaka.

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Chapter One

Agricultural Technology

Agricultural operation and agricultural technology are complementary to each other. Basically, the process which is in agricultural operation that is agricultural technologies. There is a well-defined agricultural technology for each agricultural operation. Today, agriculture is not only the subject matter of supplying food for family. It is now a business also. Previously agriculture was known as the production of crops and collection of year-round food by sowing seed and cultivating land. Now agriculture is evaluated in a view of business by calculating profit or loss based on cost involved in each technology and products' market price. So now the agricultural problems are becoming more complex; the agricultural scientists are also developing so high thought agricultural technologies. We have learnt more about the different agricultural operations with their respective technologies, agricultural implements and uses of the technologies in the previous classes. We shall learn on forward a step about land preparation, increasing fertility, crop-wise soil characteristics, soil erosion, preventing soil erosion, seed preservation, pest control, agricultural mechanization etc. matter with their respective technologies in class ix- x.



Figure: Cultivating land by power tiller

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

- select crops based on soil and environmental characters.
- describe with mentioning steps of land preparation method.
- analyse necessity of land preparation.
- explain soil erosion, causes and types of soil erosion.

- describe problems of soil erosion.
- analyse the ways of preventing soil erosion.
- describe the methods of seed preservation.
- explain the importance of seed preservation.
- preserve crop seed.
- explain the necessity of preserving fish, animal and birds feed.
- describe the steps involved in preserving fish, animal and birds feed.
- explain about supplementary feed.
- prepare list of supplementary feed for fish, animal and birds.
- describe the methods of applying supplementary feed to fish, animal and birds.
- analyse the necessity of supplementary feed for rapid growth and nutrition of fish, animal and birds.

Section-1

Crop Selection

Crop selection based on soil and environment

Soil is a medium for crop production. Crop production is completely dependent on soil properties. Soil is a natural source of water and nutrient. All crops are not grown in all soils. For example, rice plants loves clayey soil or clayey- loam soil; whereas, groundnut loves sandy or sandy- loam soil. However, since the soils of Bangladesh are formed by the siltation of the Ganges, the Brahmaputra and the Meghna, all types of crops are more or less grown here. Most of the soils of Bangladesh are loose, light, dusty and cultivable. Soil means the substance where crops can grow, forest can be developed and livestock can move. When a farmer is asked about soil, he quickly speaks that the earth surface up to which a share of plough can penetrate is soil and it is suitable for crop production. It means in farmers' language, earth surface up to 15- 18 cm deep layer is called soil. Therefore, soil properties suitable for crop production remain within this layer.

It is previously said that more or less all crops are grown in the soils of Bangladesh. But the soil properties of all the regions are not similar. For that reason, it is seen that, somewhere rice grows well, somewhere wheat, somewhere potato and somewhere jute. Soil properties suitable for crop production are described below:

Soil properties suitable for rice	Soil properties suitable for wheat
<ol style="list-style-type: none"> 1. All soils except gravel and sandy soil are suitable for rice cultivation. Clayey and Clayey- loam soils are the most suitable for rice cultivation. Rivers' tidal flood plains and haor-baor areas where silt is deposited, rice can also grows well there. 2. Based on the types of rice, it can be cultivated in high, medium and low all types of lands. For example, boro and deep water rice can be grown in low land. 3. Soils having pH range acidic to neutral are suitable for rice cultivation. 4. Soil organic matter, if lower, can be increased by applying compost. 5. Soil fertility can be increased by determining nitrogen, phosphorous, potash, zinc, sulphur etc. and applying necessary amount of fertilizer. 	<ol style="list-style-type: none"> 1. High and medium high land are suitable for wheat cultivation. 2. Loamy or sandy- loam soils are suitable for wheat cultivation. 3. Wheat is fitted well in the northern districts of Bangladesh. Besides, it is also cultivated in Dhaka, Comilla, Tangail and Faridpur. 4. Wheat is not cultivated in all the agricultural regions of Bangladesh, specially it is not cultivated in haor- baor and bill areas. 5. Wheat grows well in soils having pH 6.0- 7.0.

Soil properties suitable for Pulses	Soil properties suitable for Jute
<ol style="list-style-type: none"> 1. Pulses grow well in the loamy, sandy loam, clay loam and silt loam soils of high and medium land. 2. Pulses grow well in neutral or alkaline calcareous soil. 3. Dry and cool weather and lower rainfall are suitable for cultivation of pulses. Pulse crops shall give good yield if these conditions are prevailed and if the soil is of sandy loam to clay loam. 4. The low and medium lands are to be selected to cultivate pulses without ploughing. The seeds of pulse crops are sown in wet soil after draining out of monsoon water from the land. 	<ol style="list-style-type: none"> 1. Jute grows well in the silty fertile land of the river the Baahmaputra, the Jamuna the Meghna etc. 2. Deep silty soil of river estuarine is specially suitable for jute cultivation. 3. Jute also grows well in loamy and sandy loan soil.

Task: Learners will prepare the list of land friendly crops and will present it in the classroom.

Soil properties for vegetable crops

All types fo vegetables grow well in high, well- drained, loamy, sandy loam and silt loam soil. The soil properties suitable potato and tomato cultivation are described below:

Soil properties suitable for potato	Soil properties suitable for tomato
<ol style="list-style-type: none"> 1. Loamy and sandy- loam soil is very suitable for potato production. 2. Well- aerated soft and loose soil is suitable for potato. These conditions facilitate potato to become larger in size. 3. Potato requires adequate amount of organic matter in soil. 4. Suitable soil pH range is 6.0- 7.0. 	<ol style="list-style-type: none"> 1. Tomato can be cultivated in any types of soil except sandy soil and soils having gravel. 2. Loamy and sandy- loamy soils are suitable for tomato cultivation. 3. Tomato can be grown in sandy soil if higher amount of organic matter is added in soil. 4. Soil having pH nearly neutral is suitable for tomato cultivation.


Task: Learners will prepare a list in group mentioning in what types of crops grow well in what types of soils.

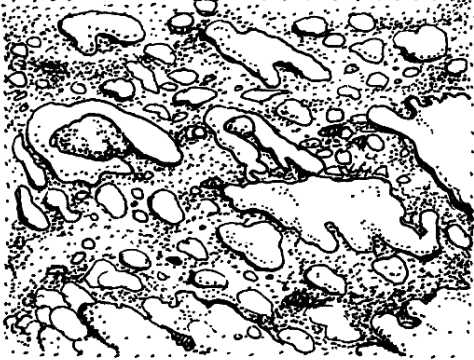
Crop selection according to the character is ties of soil- based ecological zones

From the previous lessons, we have learnt to describe soil properties based on the classification of crops. We shall learn to select crops according to the soil properties in this lesson. Soil properties means soil classes, organic matter content, potash mineral content, soil pH and soil topography. We have certainly learnt that Bangladesh is divided into thirty agro-ecological zones based on the nature or properties of soil. Actually, a certain agro-ecological zone plays a representative role for the soil of that region. An agro- ecological zone is a technology also. For agricultural activities, a vital work is to select crops according to soil properties and soil topography. An essential technology in agricultural activities is to select crops based on soil properties. The more of this technology will be used perfectly, the more consequences of the agricultural activities will be profitable. According to the structure and nature of soil, the thirty agro- ecological zones are of five types. Crop selection for this regions based on their soil properties are shown below:

1. Loamy and Silt- loam soil region
2. Clayey soil region
3. Barind tract and Madhupur tract
4. Hilly and Piedmont region
5. Coastal region

Soil - based region	Crops suitable for cultivation
<p>Loamy soil region</p> <p>Loamy soils of agro- ecological zones are 1, 2, 3, 7, 8, 9, 10, 11, 16, 19. Among these, region 9 and 19 are medium low but loamy. On the other hand, region 11 is high and loamy. All other regions under high land. Organic matter content in loamy soil is low to medium.</p>	<p>Almost all types of crops grow well in loamy soil. Loamy soil is an ideal soil for crop production. Farmers grow crops depending on the rainfall. Sometimes they grow crops depending on irrigation also. The name of rainfed and irrigated crops are mentioned below:</p> <p>Rainfed crop selection</p> <p>Rabi season: Wheat, radish, tomato, cauliflower, cabbage, okra, chili, groundnut etc.</p> <p>Kharif- I: Transplanted aus, Broadcast aman, jute (white), foxtail millet, brinjal, sesame, mungbean, broadcast aus, maize, dhaincha etc.</p> <p>Kharif- II: Transplanted aman (Local improved varieties/ HYV).</p> <p>Irrigated crop selection</p> <p>Rabi season: Boro, sugarcane, sugarcane +potato, sugarcane + mungbean, onion, garlic, wheat, potato, mungbean, mustard etc.</p> <p>Kharif- I :Transplanted aus, jute (tosa), sesame, maize</p> <p>Kharif- II: Transplanted aman (Local improved varieties/ HYV)</p>
<p>Clayey soil region</p> <p>Agro- ecological zones of 5, 6, 15, 20 and 21 are under clayey soil region. The medium high land and medium low land of these regions are clayey. But somewhere silt-clay soils are also observed. Organic matter content in soil is moderate. Somewhere organic matter content is high. Potash containing minerals are moderate.</p>	<p>Clayey soils predominant in medium low and low land in this region. Rice production is good in clayey soil. The name of rainfed and irrigated crops are given below:</p> <p>The main crop of this region is rice both in rainfed and irrigated condition. Some other crops also grow in rabi season if irrigation facilities are prevailed.</p>

Soil - based region	Crops suitable for cultivation
<p>Barind and Madhupur tract</p> <p>Most of the lands in Barind and Madhupur tract are high and medium high. Agro- ecological 25, 26, 27 belongs to Barind tract, Agro-ecological zone 28 is Madhupur tract and lands are plain and high. Soil is loamy and contains low organic matter and potash minerals. Soil pH ranges from 5.5- 6.5.</p>  <p>Figure: Loamy soil</p>	<p>High and medium high land is the characteristics of Barind and Madhupur tract. As the soil of these regions is loamy, various crops can be grown providing proper irrigation facilities. The name of the rainfed and irrigated crops are given below:</p> <p>Rainfed crop selection</p> <p>Rabi season: Boro, mango, potato, mustard, lentil, chickpea, barley and winter vegetables.</p> <p>Kharif- I: Broadcast aus, jute, foxtail millet, summer vegetables</p> <p>Kharif- II: Transplanted aman (Local improved/ HYV).</p> <p>Irrigated crops selection</p> <p>Rabi season: sugarcane, sugarcane + potato, wheat, mustard, groundnut, lentil, tomato, cabbage, chickpea, winter vegetables.</p> <p>Kharif- I: Transplanted aus, jute, mungbean, okra.</p> <p>Kharif- II: Transplant aman (Local improved/ HYV).</p>
<p>Hilly and Piedmont regions</p> <p>Agro- ecological zones 22, 29 and 30 belongs to this region. Above ninety per cent of land is high land. Khagrachhari, Bandarban, Rangamati, Cox's Bazar and Akhaura belong to this region. Besides hilly areas of many districts belongs to this region. Soil of this region is loamy. Organic matter and potash mineral content is low. Soil pH ranges from 5.0- 5.7.</p>	<p>As soils of Hilly and Piedmont regions are loamy, various crops can also be grown here. The list of rainfed and irrigated crops suitable for these areas are given below:</p> <p>Rainfed crops selection</p> <p>Rabi season: Sugarcane, mustard, lentil, chickpea, wheat etc.</p> <p>Kharif-I: Broadcast aus, jute, broadcast aman.</p> <p>Kharif- II: Transplanted aman.</p> <p>Irrigated crops selection</p> <p>Rabi season: Sugarcane, sugarcane + potato, sugarcane + lentil, boro, wheat, mustard etc.</p> <p>Kharif-I: Dhaincha, broadcast aus, transplant aus.</p> <p>Kharif-II: Transplanted aman (Local improved/ HYV)</p>

Soil - based region	Crops suitable for cultivation
<p>Coastal region</p> <p>Agro- ecological regions 13, 14, 18, 23, 24 belong to coastal region. Most of the lands are medium high land. Soils are loamy and sandy and silt- loam having low organic matter and potash mineral. Soil pH ranges from 7.0 - 8.5.</p>  <p>Figure: Silty soil</p>	<p>Saint martin island, Chittagong, Feni, Barisal belong to the main areas of this region. As the soils of this region are loamy, sandy- loam or silt- loam various types of agricultural commodities are produced here. The name of the rainfed and irrigated crops are cited below:</p> <p>Rainfed crops selection</p> <p>Rabi season: Wheat, mustard, mungbean, chili, onion, garlic, radish, brinjal, bean, tomato, groundnut, maize etc.</p> <p>Kharif- I: Brtroadcast aus, transplanted aus, jute, teasel gourd etc.</p> <p>Kharif- II: Transplanted aman (Local improved/ HYV).</p> <p>Irrigated crops selection</p> <p>Rabi season: Boro, tomato, potato, mustard, water melon, mungbean, chili etc.</p> <p>Kharif- I: Transplanted aus</p> <p>Kharif- II: Transplant aman (Local improved/ HYV)</p>

Task: Students will write a report on the nature of the soil and describe the characteristics of land of this own village

Section-2

Land Preparation for Crop Production

Land preparation is the most important operation among the agricultural activities. Land preparation for all crops is not similar. For example, at first seedlings are raised, thereafter these seedling are transplanted by preparing main field for boro and transplant aman rice. But for broadcast aus rice seeds are directly broadcasted in the main field without raising seedlings. Wheat seeds are also broadcasted almost similarly in the field by cultivating land well. Various activities are involved in land preparation such as, ploughing, laddering, fertilizer application etc. Crop-wise each activity are described below scientifically:

Land preparation for transplant aman and boro rice cultivation

Two types of land preparation are involved in transplant aman and boro rice such as, seed bed preparation & seedling raising and main field preparation.

Seed bed preparation and raising seedlings: First activity involved in transplant aman/ boro rice cultivation is seed bed preparation and raising seedlings. Seed bed can be prepared both in wet and dry condition in transplant aman rice but in boro rice only wet seed bed is prepared.

Wet seed bed preparation: High land, where monsoon water cannot be stagnant, should be selected for seed bed preparation. The size of the seed bed is dependent on the size of the farmer's main field. Seed bed of seven and half katha area is required for one hectare of main field. In our indigenous measurement, one bigha main field requires seed bed of one katha or seventy square meters. The step- wise description of preparing seed bed in one katha area is given below:

Step-1: Selection of an area measuring 10×7 square meters. Then application of 200- 250 kg cowdung or compost in this selected land. Thereafter 2- 3 ploughing operations so that the cowdung or compost can be mixed with soil.

Step-2: After ploughing properly, keeping 25 cm for drain surrounding the land, the whole area is divided into 4 pieces each having area 10×1.75 square meters. Distance between two pieces is kept 30 cm, depth of drain is kept 15 cm. Soils lifted from drain is used to elevate the seed bed. This drain is used to irrigate seed bed and to drain out excess water.

Step-3: In this step, fertilizer is applied in the seed bed. By broadcasting 250 g urea, 250 g TSP and 150 g MP, seed bed is made puddle.

Step- 4: Healthy and plumed seeds are sown in the seed bed after broadcasting fertilizers followed by puddling.

Dry seed bed is prepared similarly to wet seed bed. In dry seed bed, puddling was not done but 3 kg seeds are sown in seed bed making the seed bed soil friable. Soils are kept moist by keeping the water flow in the drain.

Seedlings will emerge if regular and necessary care is given. When the seedlings become 25- 30 days old, they become suitable for transplanting in the main field.

Main field preparation: Tillage is the first activity of land preparation. Tillage refers to the mechanical manipulation of upper most surface soil in order to grow crops so that seeds can germinate and crops can grow properly.

Main field preparation to raise seedlings: Transplant is a crop belongs to kharif –II season. Heavy rainfall occurs in this season and the land is made puddle by 4- 5 ploughings followed by two laddering. Now-a- days, rotavator connecting with a power tiller is used to make soil puddle when soil is wet. Thus the residues of previous crops and dervishes are covered by mud and they require 10- 15 days for decomposition. After complete decomposition of crop residues and dervishes, the land becomes suitable for transplanting seedlings. In boro season, there is no rainfall and the land is then made puddle by irrigation water. During puddling, the surrounding ailes- bound lands are properly spaded. To hold water, the entire land is divided into several pieces in accordance with the slope. Otherwise the water moves towards the slope and will become stagnant there. Consequently, it causes loss of water and makes fertilizer application problematic. Methods of fertilizer application in rice field have been described elaborately in the chapter 4.

Land preparation for wheat cultivation

Wheat is a rabi crop. The proper duration for wheat cultivation is from 1st November to 30th November after the end of monsoon season. The land is ploughed when 'zeo' condition exists. Soil is to necessarily make friable for wheat cultivation. For that reason, soil is made friable by 3- 4 ploughing and cross- ploughing followed by laddering. Care should be taken not to remain larger clods in the land. Loamy or sandy- loam soil is suitable for wheat cultivation as these soils become easily friable. Ploughing may also be done by rotavetor connecting with a power tiller followed by laddering. A friable soil is suitable for germination of wheat seed. We have learnt about fertilizer application in wheat cultivation in class viii.

Land preparation for pulse crops

Land preparation activities are not practiced for the cultivation of pulse crops in Bangladesh. But one or two ploughing operations are practiced for lentil cultivation. At the end of monsoon, when water is drained out from 'char; and lower areas, the lentil seeds are sown in silty soil without any tillage operation. If possible, one or two ploughings are also practiced. After ploughing, on fallow land or on transplant or broadcast aman field pulse seeds are broadcasted.

Land preparation for potato cultivation

Land preparation for potato is started from the month of Ashwin in low land after draining out of monsoon water or in the high land. Generally, potato is cultivated in loamy or sandy- loam soil. Soil for potato field is made friable by 5- 6 ploughing followed by several laddering. Now days, land is prepared with the help of power tiller. For that reason soil is made friable by 3- 5 ploughing and thereafter land is made level.

Furrow making and fertilizer application

After ploughing and leveling the land properly, several straight furrows of 10- 12 cm depth are made. The distance between furrows is kept 60 cm and seeds are sown in each furrow maintaining 15 cm between two seeds. The methods of fertilizer application in potato are discussed in the next chapter.

Importance of land preparation

Tillage is the first step of land preparation. In narrower sense, tillage is the loosening of soil with the help of implements in order to grow crops. But there are several technologies which are related to tillage. For example, placement of seeds in appropriate location and depth for germination, creating aeration facilities in soil, soil inversion, increasing micro- organism activities in soil etc. Considering these aspects, the importance of land preparation can be realized. So, to feel this importance tillage can be defined as 'The process through which the soil is cut, make weed free, soft, loose and pulverized in order to sow crop seeds properly and to provide subsequent seedling growth is called tillage'.

Tillage is the preliminary step involved in land preparation. From the beginning, men could realize the importance of tillage, i.e., the importance of land preparation. For that reason, they used to make pointed implements by wood or stone. They used to cut, loose and soften the soil to sow seeds or transplant seedlings with the help of these pointed implements. Tillage operation may vary with the crops but its importance could not be negligible.

There is a proverb of Khana about land Preparation of which meaning- radish cultivation requires sixteen ploughings to make soil friable.

Task: Sometimes learners will visit field. They will observe the prepared by the farmers for rice cultivation and will record the activities involved in land preparation in their note book. Thus learners will find out the reasons for different types of land preparation for different crops.

Eight ploughings requires for cotton, whereas, four ploughings are sufficient for rice cultivation. It is interesting that betel leaf does not require any ploughing. From this idea, 'no tillage' system is practiced in the cultivation of different crops. No a day, farmers themselves cultivate maize, pulses etc. without any tillage.

Objectives of tillage or land preparation:

The necessities of land preparation can be realized from the objectives of tillage. The objectives of tillage are enlisted below:

- 1. Bringing soil favorable for seed germination:** The process by which soil is made friable to bring it in favorable condition for seed germination and crop growth is called tillage. Repeated ploughings make the soil soft, granular, powdery. Therefore, a physical soil condition is created which is favorable for seed germination and crop growth. How does and what extent the land will be prepared is dependent on the soil types, soil organic matter and moisture, and types of crops. Tillage by 3/ 4 ploughings and laddering in light soil like loamy, sandy or sandy- loam soil can make the soil suitable for crop cultivation; whereas, the heavy soil like clayey soil require 5/ 6 ploughings. Soil become friable easily if there is judicious soil moisture during ploughing, otherwise this operation creates larger clods. The soil particles remain granular and aggregated if there is high organic matter content in soil. For that reason, seeds can remain in proper location and easily germinate.
- 2. Mixing fertilizer and organic matter in soil:** It is necessary to apply fertilizer and organic matter in soil. One of the objectives of tillage is to mix fertilizer and organic matter in soil. For that reason, after one or two ploughing, cowdung or compost should be broadcasted in soil and these are mixed with soil during subsequent ploughings. Sometimes, dhaincha is cultivated as green manure crop and it is mixed with soil before flowering to enrich soil organic matter and fertility.
- 3. Controlling soil- borne insects:** There are many insects in soil which are very harmful for crops. During tillage operation, these insects with their cocoon and eggs become open to birds and sunlight and are destroyed by them. Among the soil- borne insects, termites, crickets and ants are predominant.

- 4. Increasing water- holding capacity in soil:** Tillage increases water- holding capacity of soil. Water is quickly evaporated and moves by run- off from un- tilled land. But in tilled land, fertilizer and irrigation become hold and thereafter are absorbed in soil. Thus water- holding capacity of tilled soil is increased more. In that soil, is seeds are sown, germinate well and crop growth become quicker.
- 5. Increasing micro- organism activities in soil:** There are various micro- organisms which help to keep soil health good. Among them, fungi and bacteria are the main. These organisms, remaining in soil, help to decompose soil organic matter. By proper tillage, the activities of these soil organisams are increased. Crop plants can uptake nutrient easily and thereby increased yield.
- 6. Controlling soil erosion:** Another important objective of tillage is to level and compact the undulating land. Consequently, rain or irrigation water cannot move outside the land. Thus, controls soil erosion and uses water suitably.

Factors influencing land cultivation:

How the land will be cultivated, is dependent on some factors. These are as follows:

1. Types of crops
 2. Types of soil
 3. Weather and
 4. Types of farm
- 1. Types of crops:** Land cultivation depends on what crops will be cultivated by the farmers. For example, to cultivate rice, the land are made puddle by ploughings and cross- ploughins followed by laddering. Sorghum and sea millet do not require so much ploughing. But radish, chili etc. require such ploughing which makes the soil friable. Sugarcane and potato require deep ploughing for their cultivation.
 - 2. Types of soil:** Land cultivation depends on the types of soil. Clayey soil, having high moisture or if they are wet, cannot be ploughed. It requires waiting until reaching 'zeo' condition. Again, light soil such as, loamy, silt- loam and sandy- loam, containing high moisture, can also be ploughed. These soils are very suitable for cultivation.

3. **Weather:** Soil moisture content varies with the weather condition. Moisture deficit prevails in soil if there is scarcity of rainfall. In this condition, the land should not be deep ploughed. In this condition, if the land is ploughed deeply, there will be serious moisture deficit in soil. Again, when scanty of rainfall in monsoon season, sufficient moisture content exist in soil and the land preparation for transplant aman rice become easier.
4. **Types of farm:** Intensive crop cultivation is done beside the house- holds. In intensive crop cultivation, just after harvesting one crop another crop is instantly cultivated. At that time deep ploughing is not necessary as the soil remain loose naturally. But occasional crop cultivation requires deep ploughing.

Section-3

Soil Erosion and Erosion Control

Soil erosion

During heavy rainfall, look at the soil. You can see that when larger droplets fall on the soil, smaller holes are formed in the soil and water becomes turbid. The mud- mix water moves towards the lower slope. Thus, soil erosion occurs with mud- mix water during rainfall. Again, look at the stormy air or cyclone. You can observe that soil particles are flying with air from one location to other. These soil particles will hit your eyes and face if you remain outside. That means, soil erosion also occurs through air. Now probably you can say that transportation of surface soil due to various reasons is called soil erosion.

By the process of soil erosion, soil from one place is eroded and is deposited on the land having lowest slope. The main causes of soil erosion are rainfall, cyclone, river flow, cultivation by deforestation, cultivation on hilly slopes etc. Due to continuous rainfall, when soil lost its water- holding capacity the excess water brings away some surface soil particles towards the lower slope. By the action of water flow, surface soil becomes loose and moves to be deposited on the land having lower slope. Similarly, wind brings away the soil from the cultivated land in form of dust. River flow breaks the bank of river and brings away the soil and creates 'char' region. When men clean the forest to cultivate crops, the land becomes open. Again, livestock are also grazed. Thus soil erosion occurs. Similarly, by cleaning hilly forest, crops are cultivated on hilly slopes. By the action of the flow of rain water, surface soil fall on the valley.

Types of soil erosion:

There are two types of soil erosion: (1) Natural soil erosion (2) Soil erosion by men. These are discussed below:

Natural soil erosion: There is a large influence on soil erosion. This type of erosion has started from the beginning of earth creation. The 'char' or the islands are formed in the river estuarine or in the sea through this type of erosion. Many areas of the world become fertile and many become unfertile in consequence of this type of erosion. Naturally, soil erosion is occurring continuously but we cannot realize it.

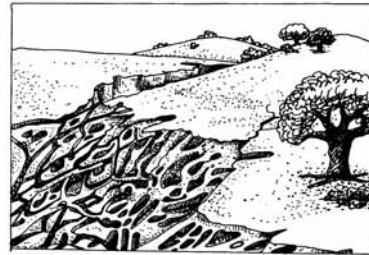


Fig. : Natural soil erosion

Wind and rainfall are the principal reasons among the natural ones. These factors bring soil particles from one location to other towards the direction of their flow. Soil erosion occurs for this is negligible and is not considered. Probably for that reason this type of soil erosion is called usual soil erosion. Natural soil erosion is also considered as the part of soil formation process. There is a balance between soil formation and soil erosion. But agricultural activities fall into a hazardous condition due to soil erosion for longer duration.

Soil erosion by men: Men require food to be alive. From the beginning of agriculture, men are using soil injudiciously to produce food. Tillage, irrigation, drainage etc. are main components of agricultural activities. Soil is continuously disturbed by these activities. Thus, lands are being open to the natural forces like rainfall, air and become eroded. The more the soil is used the more soil erosion occurs.



Fig. : Soil erosion by men

Bared lands are being attacked by the rainfall, air, and flood. Soil becomes loose due to zoom or step cultivation in the hilly areas. Hill- breaking occurs due to heavy rainfall and thus causes land erosion. This also becomes dangerous for human life and their properties. Besides, grazing of livestock and movement on the field path moves away the soil in the form of dust.

Demerits of soil erosion

The demerits of soil erosion are as follows:

- (1) The nutrient- enriched surface soil is moved away by soil erosion. Thus soil fertility is lowered considerably.
- (2) Soil erosion make soil deficit in plant nutrients. Consequently it hampers crop growth.
- (3) Continuous soil erosion fills up the river- canal, haor- bill etc. For that reason creates frequent flood visits the country. Thus it damages crops, birds, house- holds etc.

(4) A vast amount of eroded soil is deposited in the river. Thus it decreases river depth and creates problem in navigation.

(5) There is a proverb that erosion of fertile soil means the erosion of civilization.

Classification of soil erosion

Soil erosion is mainly divided into two classes. These are:

- (1) Soil erosion due to rainfall and
- (2) Soil erosion due to wind

Soil erosion due to rainfall: Large soil erosion occurs in Bangladesh due to rainfall. This soil erosion may be divided into the following classes;

- (1) Sheet erosion
- (2) Rill erosion
- (3) Channel erosion
- (4) River bank erosion

These soil erosions are discussed below:

Sheet erosion: When rain or irrigation water flows on the soil surface from the higher slope to lower slope, the upper soft and fertile soil particles is cut and moves away in the form of thin sheet. This is called sheet erosion. Soil erosion due to rainfall is not visible. But after several years, it is realized that soil fertility has decreased. The cause of decreasing this fertility is not but sheet erosion.

Rill erosion: Rill soil erosion is the second step of sheet erosion. Due to heavy rainfall, several long narrow lines are formed along the slope which looks like hand ribs. The narrow lines eventually become larger in length and width. By the flow of rain water fertile soil is removed from the land. Thus the land loss its fertility and becomes problematic to use implements.

Channel erosion: This erosion is the third step of sheet erosion. Rill erosion is the source of channel erosion. The small channels produced in rill erosion are increased in length and width due to longer durational rill erosion. Therefore, the crop soils go under more erosion. After a certain period, these channels look like drains or small rivers. The more the rainfall occurs the more channel erosion occurs. This type of soil erosion is found in the hilly regions of Bangladesh.



Fig. : Rill erosion

River bank erosion: A remarkable cause of soil erosion in Bangladesh is river bank erosion. Every year hundreds of hectares of lands go under river in Chandpur, Sirajganj, Goalanda etc. regions. At the beginning or the last of the rainy season, there creates a heavy current in the rivers and consequently the agricultural lands on the bank of river go under river.



Fig. : River bank erosion

Air erosion:

The soil transportation caused by speedy air flow from one place to other is called air erosion. The air erosion is higher where there is leveled land, comparatively lower vegetations and lower rainfall. Sandy and sandy loam soils are loose and light. Therefore, these soils easily fly away if there is speedy air flow. Again, the soil in which organic matter content is very low, air erosion is more.

The fertile regions of desert become unfertile due to sand deposition on that land by air flow. In the northern regions of Bangladesh like Dinnajpur- Rajshahi region, small amount of air erosion is found in the month of Chaitra- Baishakh. Thus, due to air flow fertility of arable lands becomes reduced.

Causes of soil erosion:

Soil erosion is caused by several reasons. From the soil erosion described above, the causes of erosion can be also realized. The causes of soil erosion are cited below:

- | | |
|---------------------------------|---------------------------|
| (1) Rainfall | (2) Land slope |
| (3) Nature of soil | (4) Nature of crop |
| (5) Methods of land cultivation | (6) Intensive cultivation |
| (7) Air | (8) Human activities |

Rainfall: Though rainfall is good for cultivation, it causes soil erosion. The intensity, number and amount of rainfall influence the soil erosion. If there is heavy rainfall the rain droplets become larger and hit the soil with high pressure and it loose the soil particles. When the soil loss its water absorption capacity, the excess water creates a flow and moves from higher slope to the lower slope. During water movement, the loose and soft soil is transported with water. The higher the speed of water flow the higher will be the soil erosion.

Land slope: Water moves with high speed towards the lower slope if the slope is higher. For that reason, the soil erosion is higher in hilly area compared to plain land. Generally, zoom cultivation practiced in Bandarbuns, Khagrachhari and Rangamati areas in Bangladesh. Consequently soil becomes loose in zoom cultivation areas and this soil moves towards the lower hilly slope with rain water if there is rainfall. Within few years, the zoom cultivation area becomes unfertile.

Nature of soil: Soil erosion depends on soil structure, texture and the presence of organic matter. The sandy- loam soil can easily absorb the rain water due to its higher porosity. For that reason, erosion of this soil is lower. But the porosity of clayey and heavy soil is lower and thereby its water absorption capacity is also lower. For that reason, in presence of a little rainfall, water becomes stagnant on soil surface and causes soil erosion moving towards the lower slope.

Methods of cultivation and nature of crops: If cultivation is practiced along the slope avoiding across the slope in the hilly areas, the soil erosion is caused due to rainfall. The steeps are created on the slant slope of the hills and crops are cultivated on that steeps. But if does not do so and try to cultivate in normal way, landslide or soil erosion may be caused. Frequent cultivation of land also may cause soil erosion.

The crops which cover the soil can escape the soil from erosion. Such as groundnut, black gram, grass pea etc. But sugarcane, maize, rice, wheat etc. do not cover the soil at their earlier stage. Consequently soil erosion occurs.

Air flow: The regions where there is low vegetation, soil erosion occurs by air. This type of soil erosion occurs in Rajshahi and Dinajpur regions.

Human activities: The actual cause of soil erosion is human themselves. To manage food for hungry, men started to clean forests. Thus soil surface become open and causes soil erosion. Besides, men destroy agricultural lands constructing residence, roads etc. and also cause soil erosion.

Ways and means of controlling soil erosion

One of the important technologies of agricultural operations is controlling soil erosion. This technology is the summation of some methods of controlling soil erosion. These methods are-

Lowering water flow:

- 1) It is important to decrease water flow for controlling soil erosion. Water flow can be decreased by several ways, such as, making bund or ails speed of water flow become decreased, soil gets time to absorb water and thereby controlled soil erosion.
- 2) If the small canals created by rill erosion are filled up and leveled, water flow will be decreased and be controlled soil erosion.
- 3) Allowing growing of weeds in the larger drain and inserting sticks and placing net with the sticks at the end of the drain, water flow can be decreased.

Facilitating well- drainage:

If water becomes stagnant in the land, rain water adding with the stagnant water, increase water flow and thereby soil from the land become loose and moves away. Therefore, dividing the land into several pieces and removing excess water separately from each piece, soil erosion can be controlled.

Increasing organic matter content in soil:

Granulation of soil becomes good if adequate amount of organic matter is applied in soil. The rain water without causing soil erosion can easily enter the soil. The land in which organic matter is lower, soil of this land is eroded easily.

Crop cultivation on the steep of hill:

In this method, crops are cultivated on the lines created across the slope hill. Since the crops are cultivated across the slope, the speed of the rain water flow becomes lower. The soil without transporting deposited near the base of the plants.

Task:

1. The learners will write a report on the soil erosion of the agricultural land in their own area with control measure.
2. The learners will write alarming poster in groups on soil erosion control and will present in the class.

Section-4

Seed Preservation

Process of seed preservation

Seed preservation is started from seed production. By sowing or transplanting in the field seed preservation process is completed. So, it is seen that seed preservation means all the operations properly done for seed production, drying, processing, quality control and marketing.

Conditions for seed preservation**Seed production:**

The following points should be kept in mind for seed production:

- 1) Crop cultivation only for seed production
- 2) Not to cultivate the same crop near the selected land.

- 3) Collection of seed from reliable organization for seed production.
- 4) Removal of crop plants of other varieties during seedling growth.
- 5) Frequent field inspection of seed crop for (A) controlling weed (B) removal of crop plants of other varieties (C) taking appropriate measures to control insect pests and diseases
- 6) Keep care to crop maturity.
- 7) Cleanliness in crop harvesting. Threshing and winnowing.

Seed drying:

Seed drying is required for higher seed longevity and controlling insect infestation. There is no alternative of seed drying to increase seed viability and seed germination. Actually, seed is dried to bring the seed moisture content to a standard level. At the time of harvest seed moisture content remains 18% to 40%. This moisture level deteriorates seed viability. For that reason to use this seed in the next season, it is essential to lower seed moisture content at 12% or below. So seed drying is necessary.

Methods of seed drying:

There are two types of seed drying. These are: (1) a) seed drying in the natural or normal air b) seed drying by enforcing natural air and (2) seed drying by enforcing heated air in the seed container.

If moisture content of the surrounding air is higher than that of seed, the moisture from air moves towards the seed until moisture equilibrium is being existed. To keep seed moisture at safe level, it is necessary to keep surrounding air dry.

Duration of seed drying depends on (1) seed moisture content (2) Air temperature and humidity (3) Velocity of air and (4) Amount of seed.

It should be kept in mind that, (1) drying of seed at very high temperature is injurious to seed. For example, decrease seed viability and seed germination. (2) this type of injury may occur if seed is drying at lower temperature.

If seed is dried at appropriate temperature-

- ☐ • ☐ high quality seed is available.
- ☐ • ☐ seed is preserved for longer duration.
- ☐ • ☐ possibility of higher economic benefit from seed business is increased.

Seed processing:

Seed processing may be defined as all the operations done for seed separation after harvesting and to maintain seed quality and germinating ability until next sowing. The important activities for seed processing are to divide seed according to seed size and lastly to take measures for preservation.

The facilities achieved by proper processing-

- 1) increase seed purity;
- 2) looks attractive;
- 3) increase germination capacity.

Seed quality control:

Seed quality control means the activities involved in production and processing of seed to ensure quality seed which includes seed production by applying appropriate agronomic practices; crop harvesting, threshing and winnowing in proper way, bringing safe moisture level by appropriate drying method etc. In all the activities there is an scope to control seed quality.

The following activities are of emergency to control seed quality:

Purity test:

There are (1) pure seed (2) weed seed (3) other crop seed (4) inert matter (stones etc.) present in a seed sample. Among these four components, determination of the percent amount of pure seed is known as purity test.

Seed germination test:

How many seeds in a seed sample are germinated on percent basis is determined by a test. This test is known as seed germination test. When seed moisture content exists 35- 60% or above germination is started. It is expressed in per cent basis. 100 seeds are calculated and these seeds are then kept in pot containing sandy soil and water is applied to it to keep it wet. Every day it is observed so that the water is not empty. After certain period, seed germination will be started. The number of seed germinated will be the rate of seed germination.

Seed moisture test:

The methods of determining the amount of moisture present in seed by removing moisture from seed is known as seed moisture test. It is expressed in percent basis by the following formula:

Weight of seed sample before drying- Weight of seed sample after drying

Formula:
$$\frac{\text{Weight of seed sample before drying} - \text{Weight of seed sample after drying}}{\text{Weight of seed sample before drying}} \times 100$$

Seed vigor test:

An unfavorable condition to seed germination is created for this test. It is considered that which seed will germinate much will be of higher seed vigor.

Seed marketing:

Seed marketing is a remarkable part of seed technology. Seed collection, packaging, seed preservation before sell, notification, selling etc. all activities are combined known as seed marketing.

The formations are to be given to the customers during seed marketing:

- | | |
|--------------------------------|--|
| 1) Variety of seed | 7) Seed longevity |
| 2) Amount of seed | 8) Name of the seed grower/ organization |
| 3) Certified seed or not | 9) Name of the seed certification agency |
| 4) Seed germination percentage | 10) Seed marketing system |
| 5) Seed purity percentage | 11) Order for seed preservation |
| 6) Seed moisture content | 12) Seed price |

Importance of seed preservation:

Seeds are very sensitive. A minimum carelessness deteriorates a large amount of seed. Farmers preserve seed in accordance with their own experience. Although only the objective is to sell healthy and vigorous seed in the next season, but there developed different seed preservation methods to keep care not to deteriorate seed viability. Seeds are deteriorated during harvesting, threshing and transportation. Ten percent crops are damaged by rats, birds, fungi, moisture etc. Besides, dust, concretes etc., remaining in seed also deteriorate seed quality.

The main objectives of seed preservation are to maintain seed quality and be careful and prevent the factors which can hamper the seeds.

Methods of seed preservation:

There are several methods of seed preservation in Bangladesh. Different seeds require different methods of seed preservation. Such as for cereal crops like rice, wheat, maize seeds, rice gola, dool earthen pot, gunny bag, poly bag and bed are used. The methods of seed preservation are discussed below:

Seed drying and preserving in gunny bags:

Seed drying means the removal of excess moisture from the seed and bringing it at a safe level. It is better if moisture level is 12- 13%. In Bangladesh, seed is dried in the sunshine. To bring this moisture to 12- 13%, seeds have to be dried for three days in the high intensity sunlight. To ensure proper drying, the seeds should be tested by biting seed. If the seeds creates a sound as 'kot' on biting, it ensures the proper drying. Thereafter the seeds are kept in the gunny bags and close the openings and kept in the store house. The neem leaves, neem roots, dust of apple seeds, bishkantali etc. are mixed with the seed bags to escape the seeds from insect attack.

Preservating in rice gola:

To preserv rice, rice gola is used. The size of rice gola is constructed depending on the amount of seed. Before keeping seeds, a layer is made by cowdung and soil on the inner and outer layer of the gola and make suitable for preservating seeds. The seeds should be kept in the gola so that the gola becomes air- tied. For that reason, by closing the opening of the gola a layer is made by cowdung and soil on the opening of the rice gola.

Preservation in dol (large hollow basket)

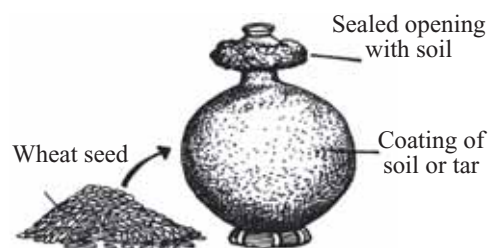
Dol is smaller than rice granary in size. Dol is lower capacious seed pot than rice gola. It is round shape made of bamboo or wood. Like rice gola, inner and outer side of the dol is coated with the mixture of cow dung and soil and it is made suitability for preserving seed after well drying.



Fig: Seed preservation in dol

Preservation in polythene bag:

Now-a-days, seed can be preserved in polythene bag of 5 kg capacity. The bag has been invented by RDRS. Polythene for keeping seed is thicker than normal polythene. Dry seed should be kept in polythene bag so that no space is available in bag and the air is totally removed out from the bag. After that, bag opening should be sealed by applying heat so that there is no scope for entering air into the bag from outside.

**Preservation in Motka (earthenware jar):**

Motka is a soil made round pot. It is most popular in the rural areas. It is made containing thick layer so that it should not be broken by a slight stroke. Coating of soil or tar is applied on the outside of Motka. Dry seed should be fully filled up in the motka and it is placed in a specific area of the slat in a rice gola room. After that a lid is to be placed for covering motka and sealed with coating.

Home Task:

Learners will make a report about a method- how to preserve seed in earthenware jar and submit in the class and then represent.

Section-5**Feed Conservation****Importance of conservation of fish feed**

It is necessary to provide supplementary feed along with natural food to the fish for profitable fish culture. In modern fish culture, 60% expenditure of total cost is required for purchasing feed. Generally rice polish, wheat bran, mustard oil cake, sesame oil cake, fish

meal, blood meal and meat offal, aquatic plants like water hyacinth, khudi hyacinth etc are used as supplementary feed in our country. Farmers prepare fish feed by mixing with above ingredients. Commercial feed manufactured in the factory can also be used in fish farm. It is necessary to require the feed of good quality even whatever feed types provided in the fish pond. If we do not provide quality feed, we will not get healthy fry and fish, they will be affected by disease and fish mortality will be increased. Besides, fish growth will also not be achieved expectedly. To maintain quality in feed, it is very important to conserve and preservation of feed and their ingredients properly. Feed quality and weight can be affected during feed conservation and preservation by the following factors:

1. **Moisture in feed:** Fungus or insects may affect if the moisture content in feed is more than 10%.
2. **Relative humidity in environment:** If the relative humidity in environment is more than 65%, fungus or insects may grow in feed.
3. **Temperature:** Feed nutrients are deteriorated by high temperature. Insects may grow well at 26-30° C and they can eat the feed and bacteria can multiply through their faeces.
4. **Sunlight:** Some of vitamins may be deteriorated by ultra violet ray within few minutes if the feed kept open at sunlight.
5. **Oxygen:** If the feed is kept in open condition, environmental oxygen causes rancidity in feed (oxidation of fat) which affects the feed quality. Oxygen also helps to grow fungus and insects.

Proper methods for feed conservation:

a) Dry feed and feed ingredients

- 1) Feed should be conserved in air tied polythene or bag, or in a covered place which is cool and dry. It is wise if these feeds sometimes are dried again in the sunlight.
- 2) Feed should be kept in room with clean, dry, safe and well ventilation.
- 3) In storage room, conserved feed should be kept on wood pallet with 12-15 cm height from the floor.
- 4) Ash can be spread under and around the feed bag to control insects.
- 5) Feed should not be stored for more than three months. It should be used up within the time.
- 6) Feed should be preserved in a place free from rodents and other animals.
- 7) Feed should not be kept with insects and other toxic substances.

b) Moist/ wet feed ingredient

- 1) Feed prepared with small fresh fishes should be provided instantly. Otherwise, it should be preserved in refrigerator.

- 2) Feed composed of oily/fatty should be kept at low temperature in a black coated or non transparent pot.
- 3) Vitamins and minerals should be kept in refrigerator with a pot free from air and light.

Task:

Learners will discuss about feed conservation method and represent on a poster.

New word: Rancidity

Importance of conservation of livestock feed and conservation method

Feed conservation may be defined as a method of processing of feed by maintaining their quality and nutritional value for future use. Moreover, feed after making can also be conserved by preservation to maintain the quality of feed.

Importance of feed conservation

In Bangladesh, most of the livestock feeds are crop by products. These by products are available after harvesting of crop or grain processing. Green grasses remain surplus even after feeding of livestock due to their huge production in rainy season. On the other hand, excess leguminous grasses are also cultivated during winter. So, these surplus green grasses need to be conserved and can be supplied to livestock during scarcity. The main objective of feed conservation is to protect feed from microorganisms and spoilage. Concentrated feed of livestock can be conserved long time in a moisture controlled room. Fungus can grow if the moisture content high in feed. Fungus affected feed causes toxicity in livestock. Sometimes, bird dies after sickness.

Steps for feed conservation

- a) Green grasses can be conserved by making hay. In part 2, hay making has been discussed. Furthermore, different steps for hay making are also given below-
 - 1) Leguminous grasses e.g. green kheshari, black gram are more suitable for hay making.
 - 2) Grasses should be cut at flowering stage.
 - 3) Moisture content of grass should be maintained at 15-20% by sun dry.
 - 4) Grass after drying should be kept on slat by piling or in tin shed.
- b) Green grasses can be conserved by making silage. In part 2, silage making has been discussed. Furthermore, steps for silage making are given below-
 - 1) Maize, Napier, Guinea grasses are more suitable for silage making.
 - 2) Grasses should be cut with fresh condition at flowering stage.
 - 3) After cutting, grass should be kept in air tied area or silo pit.

- 4) Molasses solution should be sprayed over the grasses during keeping in silo pit.
- 5) Then, silo pit should be protected from air circulation.



Fig: Suitable condition for maize cutting for silage Making

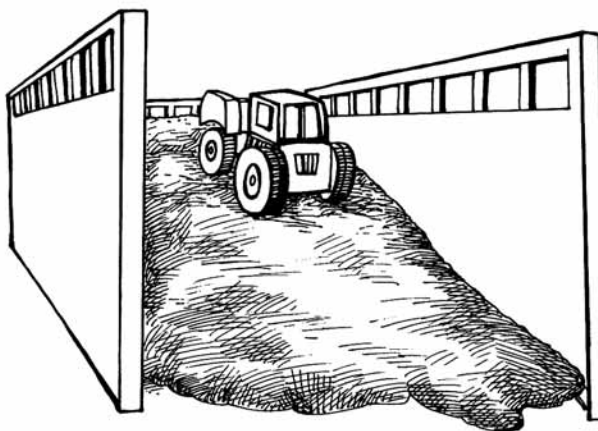


Fig: Silo pit is being filled up with green grasses

- c) Crop residue can be conserved by straw making. In our country, most of the farmers use straw as livestock feed. Farmers provide 3-4 kg dried straw to livestock daily. It is a roughage feed. Steps for making straw are given below-
 - 1) After cutting crop plants (rice, maize, khesari etc.) from land, grains are separated by harvesting.
 - 2) Crop residues are sun dried and moisture content decrease to 15-20% for straw making.
 - 3) Straw should be kept by piling.
 - d) Grain and oilseed by products can be conserved after collection. Rice polish, wheat bran, khesari bran, oil cake are the by products of rice, wheat, khesari and black gram, respectively. These by products can be conserved after collection.
 - e) Feed can be conserved by processing in feed industry, such as mash, pellet and crumble feed are produced for poultry by processing of concentrated feed.

Section-6

Supplementary Feed for Fish

Introduction and importance of supplementary feed for fish

Phytoplankton (macroscopic plants), zooplankton (macroscopic animals), khudi hyacinth, small aquatic insects, insects of bottom layer of the pond, larvae, earthworms, small snails, oysters, dead organic materials etc. from natural environment of the pond are taken by fishes as feeds for body growth and their living. But the fries are released in the pond with high density to get more production in fish culture. In this situation, only natural feeds are not sufficient for rapid growth of the fish and production with economic benefits, even it will not be sufficient for increasing natural feed by applying fertilizer. For this reason, additional feeds from outside source should be provided along with natural feed. This is called supplementary feed. Such as- rice polish, mustard oil cake, fish meal, etc. As grass carp and Shwarpunti, are vegetarian, they can be provided khudi hyacinth, kuti hyacinth, soft leaves of vegetables and grass as supplemented feed in the pond. Care should be required for availability of different nutrient contents like protein, fat or oil, carbohydrate, mineral, vitamin in supplied supplementary feed as required amount. The supplementary feed which is formulated keeping all nutrient contents in the required level known as balanced supplementary feed.

Source of supplementary feed for fish

Variety of feed ingredients is used to formulate supplementary feed for fish. The ingredients can be divided into two groups on the basis of source. Such as- A) Plant origin, B) Animal origin. Some examples are given below-

A. Plant origin: Some remarkable ingredients of animal origin are rice polish, wheat or pulse bran fine, mustard oil cake, sesame oil cake, wheat flour, molasses, khudi hyacinth, leftover of kitchen, various soft leaves like sweet pumpkin, banana leaves, cabbage etc.

B. Animal origin: Some ingredients of animal origin are fish meal, silkworm meal, shrimp meal, crab meal, bone meal, flesh of snails, blood meal etc.

Advantages of supplementary feed

1. Fries with high density and adult fish can be cultured if provided supplementary feed regularly.
2. Big size healthy fries can be produced within the short period.
3. Livability of fries is increased.
4. Disease resistance of fishes is increased.
5. Body of fish grows rapidly.

6. Fries are free from nutrient deficiency diseases.
7. As a whole, it is possible to get more fish and economic benefits from the water body within the short period of time.

Task: Learners will collect some easily available feed ingredients and write down their name in note book.

Nutrient requirement of fish and supplementary feed chart

Requirement of feed and nutrition may be varied on the basis of fish species, age and size. According to species, supplementary feed should be provided at the rate of 10-20% of the body weight for fry, 5-10% for finger ling, and 3-5% for adult fish. It is necessary to present various nutrients in the fish feed for healthy fish and their rapid body growth. Out of these ingredients, protein is important and valuable. It should be available high level in feed. That's why nutrient requirement of fish means mainly their protein requirement. Nutrient contents like carbohydrate, oil and minerals are more or less available in the ingredients used in fish feed. If protein requirement is met up in feed, other nutrients in feed will not be so deficit. According to species and the different stages of lifecycle, protein requirement will be 30-40% for carp or rui fish, 30-45% for shrimp and 35-45% for cat fish or magur.

When the fish production is continued in a pond by providing supplementary feed, amount of feed consumed by fish and amount of fish produced-can be calculated by the determination of feed conversion ratio or FCR. By this way, "which feed is better"- can be evaluated by FCR comparing with different feeds. FCR may be defined as the ratio of feed supply and the body growth of animal after feed consumption. Therefore, amount (kg) of feed provided for getting 1 kg body weight of fish is meant feed conversion ratio.

$$\text{FCR} = \frac{\text{Supplied feed for fish}}{\text{Body growth}}$$

Body growth= Total weight during harvesting fish- total weight during stocking (fry)

For example, some fries of total 1 kg body weight are released in a pond. By providing regular feed, at the time of harvesting after 6 months, total 15 kg fishes are obtained. A total 21 kg feed has been supplied to the fish during the last six months.

$$\text{So, FCR} = \frac{21}{15-1} = 1.5$$

FCR value is always higher than 1. The lesser the FCR value indicates the better feed quality. Therefore, more fish production can be obtained by using this feed.

For making supplementary feed for carp or rui, a chart for mixture of various feed ingredients is given below-

Chart for mixture of various feed ingredients

Name of feed ingredient	Feed for mixed culture		Feed for nursery or fry	
	Inclusion level (%)	Protein supplied (%)	Inclusion level (%)	Protein supplied (%)
Fish meal	10.0	4.2	21.0	12.1
Mustard oil cake	53.0	6.3	45.0	13.7
Rice polish	30.5	9.2	28.0	3.3
Vitamin and mineral	0.5	-	1.0	-
Molasses	6.0	0.3	-	-
Wheat flour	-	-	5.0	0.9
Total	100.0	20.0	100.0	30.0

** For mixed culture FCR 2.0 ** For fry culture FCR 1.5

Preparation method for supplementary feed for fish

At first, good quality specific feed ingredients should be collected. If necessary, ingredients can be grinded in a grinder machine or in a husking pedal and passed through the sieving equipment. According to formula, ingredients are weighed one by one and mixed properly in a mixer machine or in a big pot. A semi fluid state or paste will be made by stirring the mixed ingredients with water. Now small sized balls will be made from the paste and supplied to fish as wet or moisture state. Flour or molasses can be used as binder in supplied fish feed for more stability in water. Wet or moist feed should be prepared as per requirement before daily supply.

Besides, using the paste, pellet or concentrated feed can be made by native pellet machine easily and economically. In this case, pellet or concentrated feed should be dried up and stored in air tied plastic bag for subsequent using. Some toxic substances are available in oil cakes which are harmful for fish. That's why; oil cake should be used after soaking in water for a day. The soaked water should never be used for fish feed formulation. For preparing balanced feed, 0.5-1% vitamin mineral premix need to be used with selected feed ingredients. Vitamin mineral premix is available in the market.

Application method of supplementary feed for fish

1. Fish usually takes feed at day time. So, daily required feed is to be divided into two parts: one part in the morning and remaining part in afternoon should be provided in the cultured pond. On the other hand, shrimp takes feed at night and that's why; they are provided at evening or night.

2. According to species, supplementary fish feed can be provided at the rate of 10-20% of their body weight for fry, 5-10% for finger ling and 3-5% for adult fish. Average body weight can be obtained by taking few fishes from the pond through casting net once week for fry culture and once a fortnight or a month for mixed culturing. Total weight of fish in the pond can be calculated by multiplying average body weight with the total fish which were released initially in the pond. In this way, feed amount is to be fixed by adjusting with the body growth.
3. If grass carp or shwarpunti are cultured in the pond, khudi hyacinth, kuti hyacinth, green grass, helencha, soft portion of water hyacinth and various tree leaves like cabbage, spinach, banana tree leaves should be provided in the pond. For this purpose, a square sized frame has to be made by using the pieces of bamboo or branches of tree. Frame should be placed in the pond water with the help of pole so that it can be stable in the same place. Above mentioned feed can be provided on this feeding frame or ring and it is to be cleaned frequently.
4. Dry feed can be supplied by spreading on water. On the other hand, moist or wet feed should be supplied on feeder tray or slat placing in the pond water 30-60 cm deep from the top. This reduces the wastage of feed.
5. Feeds are to be supplied daily at the 3-4 specific areas around the pond in a certain time. This will ensure the best utilization of feed.
6. As the body growth of fish is less in winter, application of feed should be reduced to half or one third of the normal feed supply.
7. If the pond becomes deep green, feed applying should be stopped.
8. If feed remains after passing enough time of feed supply, it means that supplied feed is more and in this case, the amount of feed should be reduced.

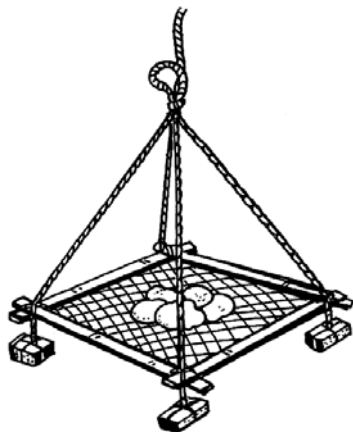


Fig: Feeder or tray

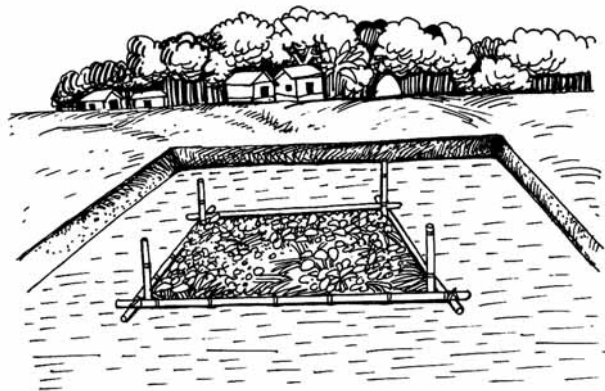


Fig: Feeding frame/ring

Task: Learners will visit a nearer fish farm and observe supplementary fish feed preparation and their application method. They will write a report and submit.

New words: Blood meal, bone meal, shrimp meal, feeding frame/ring, feeder, feed conversion ratio (FCR).

Supplement feed for Livestock and poultry

Along with conventional feed, special feeds are supplied to the livestock and poultry for increasing their production efficiency. In this way, livestock grows rapidly and becomes well nourished. Meat, egg and milk production of livestock is also increased. So, feed supplementation play a very important role for livestock rearing.

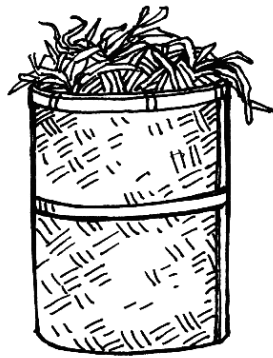


Fig: Wet straw by mixing with urea solution



Fig: Urea solution is being added in straw

Making and using of different supplement feed

a) Urea molasses straw: Using urea Straw processing-

Ingredients

- | | |
|--------------------|----------------------|
| 1. Straw : 20 Kg | 4. A medium size pot |
| 2. Urea : 1 Kg | 5. Gunny bag & |
| 3. Water: 20 litre | 6. Thick polythene |

Preparation method

1. First, 1 kg urea is mixed with 20 liter of water in a bucket.
2. Cow dung and clay mixing is used for coating around the dol (large hollow basket) and then dry.
3. Urea solution is sprayed over the straw placing gradually in the dol.
4. After placing all straw treated with whole urea solution in the dol, open end is to be tied by gunny bag and thick polythene.
5. After 10 days, straw is taken out and conserved after sun dry.

Using method:

1. 2-3 kg urea treated straw supplied to the cattle daily.
2. 300g Molasses is added to straw daily.

b) Urea molasses block: Making urea molasses block with concentrate feed.

Ingredients:

1. Wheat bran : 3 kg
2. Molasses : 6 kg
3. Urea : 90g
4. Salt : 35g
5. Edible lime : 500g
6. Vitamin mineral premix: 50g
7. Wood frame (for making 1 kg block)



Fig. Ingredients for making urea molasses block

Preparation method:

1. Firstly, molasses and some vitamin mineral mixer are slightly condensed by heating in a iron pan.
2. Urea, lime, salt and wheat bran are added in the pan after taking out of the heater.
3. Blocks are prepared by putting mixed ingredients in the frame just after adding some of bran in it.
4. Blocks are conserved in a place free from air and light.

Using method:

1. Cattle are allowed for licking 300g block daily.
2. Some of bran and salt may add on block if the cattle refuse licking initially.



Fig. : Urea molasses block

C. Feeding algae to livestock

Algae: Algae is a kind plant which is unicellular or multicellular. But, two special types of unicellular algae species are discussed here which may be used as livestock

feed. Chlorella is the main among them. They can survive on photosynthesis by using sunlight, dissolved oxygen in water, carbon dioxide and organic nitrogen. They grow rapidly in tropical climate as Bangladesh.

Nutritive value of Algae

Algae is the most prospective nutritious animal feed which may be used as the replacement of various protein rich feed like oil cake, fish meal etc. Algae contain 50-70% protein, 20-22% fat and 8-26% carbohydrate on dry matter basis. Besides, enough vitamin C and various types of vitamin B are available in algae. It is possible to increase meat and milk production with low cost by using algae water.

Necessary ingredients for Algae production

1. Algae seed
2. Artificial shallow pond or water body
3. Clean and transparent water
4. Black gram or other pulse bran
5. Urea

Method of Algae production

1. At first an artificial water body has to be made under the flat or shady place. Water body may be of 3 meter long, 1.2 meter wide and 0.15 meter deep. Its bank may be made of soil or bricks. A transparent polythene sheet containing 3.35 meter long and 1.52 meter wide should be placed for covering the bottom and bank of the water body. The area of water body may vary according to necessity. Algae can also be cultivated in a manger made of soil or cement.
2. After that 100g black gram or another pulse bran is soaked in 1 liter of water overnight and then water is collected by straining with cloth.

In this way, bran can be used at least three times and then supplied to the cattle as feed.

3. 200 liter clean tap water, 15-20 liter algae seed and black gram bran mixing water are mixed properly in an artificial pond. Then 2-3g urea is added to the pond water and mixed properly.
4. Then algae water is stirred at least three times in every morning, noon and afternoon. If 1-2g urea is applied in pond every 3-4 days interval, it results good yield.

5. Thus, after 12-15 days of production, algae water can be provided to cattle. In this time, algae water becomes deep green colour. Algae water can be provided directly to cattle collecting from pond. Everyday, it is possible to produce 50 liter algae water from a pond of 10 square meter area.
6. After providing algae water to cattle from a pond, fresh water; urea and bran mixing water can be added again in the same way to cultivate algae. No algae seed is required to add in that time.
7. Changing algae water colour from deep green to brown indicates the spoilage of culture. Then new culture will need to be started.

Feeding method:

1. Instead of fresh water, algae water can be provided to cattle such as calf, growing cattle, milking or pregnant cow and bullock.
2. In this case, no extra water needs to be provided to cattle.
3. Algae water can also be provided by mixing with concentrated feed and straw.
4. Algae water should not be provided in warm condition; otherwise, nutritional value may be deteriorated in this way.
5. Algae should be cultivated in 5 artificial ponds for a farm containing 5 cattle so that if the water is finished in one pond, then another pond would be ready for use.

D) Supplementary feed making in the market: For sustainable livestock production, supplementary feed making in the market need to be provided to cattle.

1. Protein supplementary feed- such as protein concentrate
2. Mineral supplement- Vitamin-mineral premix
3. Vitamin supplement- Vitamin-mineral premix

E) List of supplementary feed for calf-

Milk Replacer: It is a kind of liquid feed containing the contents available in milk which is prepared by special process and can be used for calf in place of milk. It contains 20% protein and more than 10% fat. Its ingredients are mixed with hot skim milk or water.

Using method: 0.5 to 3 liter can be provided according to calf age.

A sample preparation of milk replacer is given below-

Serial No.	Ingredients	Ration-1 (%)	Ration-2 (%)
1	Skim milk	65	-
2	Skim milk powder	-	06
3	Water	-	60
4	Vegetable oil	20	20
5	Whey milk	10	09
6	Vitamin-mineral premix	05	05
	Total	100	100

Calf Starter: It is a special concentrate mixture suitable for feeding calf which contains more than 20% digestible protein and less than 10% fiber. A sample calf starter is given below-

Serial No.	Ingredients	Quantity (%)
1	Cotton seed	38
2	Corn	30
3	Barley	10
4	Whey powder	10
5	Wheat bran	10
6	Bone meal	1
7	Common salt	1
	Total	100

Task: Learners will prepare a list of different feed ingredients for cattle

Using method: 0.5 to 3 Kg can be provided according to calf age.

Exercise

Short Answer questions

1. Write down the 2 characteristics of soil for each pulse crop.
2. What are the reasons for soil erosion?
3. Write down the name of required ingredients for algae culture.
4. What is called milk replacer and calf starter?

Which one is correct of the following?

- A. i & ii
- B. i & iii
- C. ii & iii
- D. i, ii & iii

5. Which one is the reason for suggestion giving by Agricultural Officer to Tasfi about making ail?

- A. To control land fertility
- B. To prevent soil erosion
- C. To increase crop production
- D. To improve soil texture

Creative Question

1. Shafiq and Rafiq, two friends live on agriculture. Shafiq has raised rice seedling by proper method. He has made a seed bed of 2 katha for boro rice cultivation. On the other hand, Rafiq purchased rice seedlings from his neighbor and he completed planting of rice seedling in his muddy land situated in beel without ploughing.

- A. What is soil?
- B. Explain the importance of making drain between seed beds.
- C. Describe a design for a seed bed making in the Shafiq's land.
- D. Evaluate the Rafiq's activity for crop production in the land.

2. Rita Paul has started for fish culturing after taking training from Fisheries Department. He properly applied supplementary feed in the pond after preparation and got success for increasing fish production. Seeing his success, other farmers of his area have taken activity for applying supplementary feed regularly.

- A. What is supplementary feed?
- B. Why is the natural feed not sufficient for fish culture? Explain.
- C. Explain the reasons for Rita Paul's success.
- D. Evaluate the activities taken by other fish farmers.

Chapter Two

Agricultural Inputs

Crop seed and propagating materials are the most important inputs among the basic elements of crop production. We can produce crop year by year using these inputs. Besides, using these inputs, we can also acclimatize a new crop in a country, conserve genetic characteristics of a crop and improve a crop by applying biotechnology.



Figure: Rice seed

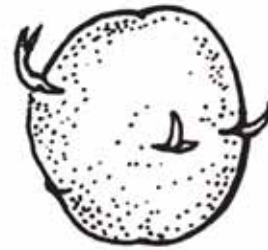


Figure: Potato seed tuber

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

- ☐ • ☐ describe the crop seed and propagating materials.
- ☐ • ☐ explain the importance of crop seed propagating materials.
- ☐ • ☐ describe the types of fish pond and steps in pond preparation.
- ☐ • ☐ explain the importance of pond preparation.
- ☐ • ☐ describe different layers of pond and explain the pond ecosystem.
- ☐ • ☐ describe permanent, seasonal pond and hatchery and explain their necessity.
- ☐ • ☐ explain the importance of fish culture.
- ☐ • ☐ explain the importance of 'Fish conservation policy' to save fish households.
- ☐ • ☐ describe the types of poultry houses and steps in poultry house preparation.
- ☐ • ☐ explain the importance of poultry house preparation.
- ☐ • ☐ explain the poultry feed and their importance.
- ☐ • ☐ describe the types of livestock houses and steps in livestock house preparation.
- ☐ • ☐ describe the livestock feed and the methods of livestock feed preparation.
- ☐ • ☐ Explain the importance of livestock feed.

Section 1

Crop Seed and Propagating Materials

Seed is the principal medium for reproduction of plant. Generally, the part which is used for plant regeneration is called seed. To get clear idea about seed, we can understand seed in two ways, such as:

- a) Botanically, fertilized and mature ovule containing an embryo in a dormant state is called seed. This type of seed is also known as crop seed or true seed or botanical seed. e.g., rice, wheat, mustard, sesame, bean, cowpea, tomato, cauliflower, chili. Cumin, dhaincah, berry, jackfruit etc.
- b) Agronomically, any plant part (root, leaf, stem, bud, branch) which can produce a new plant of its own type in favorable condition is called propagating material. This type of material is also called agronomic seed or vegetative seed. e.g., mango stem cutting, potato tuber, vine of sweet potato, sugarcane sett, pathorkuchi leaf, root of teasel gourd, stem and bud of rose, crown of pineapple, banana sucker, zinger, turmeric, garlic, aroids and all botanical seeds.

Therefore, we can say that, all botanical seeds are agronomic seeds but all agronomic seeds are not botanical seeds.

Task: Learners will collect rice seeds of rice, wheat, radish, chili crops and stems of potato, zinger, marigold, mehedi and will submit in the class in group.

Steps in crop seed production:

Seed production is a complex process. To get improved quality seed it is necessary to produce seed following appropriate rules and methods. The steps involved in crop production and seed production are the same. Difference is that to produce various crop seeds like- rice, jute, wheat, radish, chili etc., special care are to be given to the following steps:

- 1) **Land selection for seed:** Fertile land should be selected for seed production. Land should be of weed free and proper light and aeration. If the same variety of the crop is not cultivated in the selected land in the previous year then it is good for seed production. The selected land should have at least 2% organic matter content.
- 2) **Isolation distance:** To produce seed, there should be a secured distance between the selected land and the nearby land of the same crop. This distance is called isolation distance. The objective of maintaining this distance is not to mix other varieties of the same crop with the expected crop genetically.
- 3) **Seed collection:** Seed collection is an important step in seed production. Certified seed must be collected for seed production. During seed collection, the following information is to be informed:

A propagating material i.e., as an agronomic seed, steps involved in production of seed potato are cited below:

Method of seed potato production

Land selection and preparation: Well drained sandy- loam soil is the most suitable for higher yield of seed potato. Selected land is to be 30 meter far from the field of other potato crop, chili, tomato, and tobacco etc. belong to Solanaceae family. Soil should be made friable and weed free by 5-6 ploughings. Ploughing should be of 15 cm depth. If soil is much dry, the land should be brought to 'geo' condition by flood irrigation and thereafter seed potato should be planted.

Seed treatment: Seed potato should be treated with boric acid before it germinate (dipping seed potato 15- 20 minutes in 1litre water + 30 g boric acid thereafter drying in shade) if it is not treated before storing cold storage.

Seed preparation: Planting whole potato tuber is suitable as the possibility of infection by diseases after planting is lower. If planted cut tuber, the each cut piece should have at least two eyes. During cutting potato tuber, knife should be washed with soap- water to protect contamination of tubers. Cutting should be along the tuber not across the tuber.

Soil treatment: It is better to mix 80 g stable blitching powder per decimal area to prevent bacterial wilting.

Fertilizer application: There are two reasons for which balanced fertilizer application in potato is essential. Firstly, balanced fertilizer increases potato production and improves quality of the potato. Secondly, determination of the viral diseases becomes complex due to lack of any plant nutrient. It is necessary to apply fertilizer for potato cultivation In Bangladesh as following rate:

Half amount of urea, whole amount of cowdung, TSP, MP, gypsum, magnesium sulphate, zinc sulphate, boric acid should be mixed well with soil during final land preparation. Rest amount of urea should be applied at 30- 35 days after planting when earthing up is done and thereafter irrigation water should be applied.

Name of fertilizer	Per decimal
Decomposed cowdung	40 kg
Urea	1400 g
TSP	900 g
MP	1060 g
Boric acid	25 g
Zinc sulphate	50 g
Gypsum	500 g
Magnesium sulphate	-

Seed rate and planting time: Seed rate depends on planting distance and seed size. Generally, 1.5 to 2.0 ton per hectare seed potato is required (600 – 800 kg per acre).

Planting distance:

Distance	In case of whole potato tuber (cm)	In case of cutline potato tuber (cm)
Line to line	60	60
Seed to seed	25	10- 15

Irrigation management: Two to four irrigation should be provided in potato field based on the soil moisture. Light irrigation may be provided for seed germination if sufficient moisture is not present in soil, but higher irrigation water may cause rotting of seed potato. After 30 -35 days after planting, irrigation water is to be supplied just after urea top dressing. Because within 30 days stolons are started to be developed. Generally, 2/3 of the ridge is wet by water.

Weeding: Up to 30 days of planting, the potato field should be kept weed free. Generally, at the early stage, the field should be kept weed free as far as possible. Besides, lambs quarter type weed, which acts as virus transmitter, must be eradicated.

Earthing up: It is necessary to uplift soil along the valley at 'geo' condition prevailed after irrigation and urea top dressing. Another subsequent earthing up along the valley may be necessary so that potato tuber and stolons are not exposed to air and sunlight.

Roguing: Roguing should be started from germination. The diseased plants should be uprooted and burnt.

Disease and insect control

(a) Potato diseases: Among the potato diseases, the blight, bacterial wilting, scab, stem rot, viral diseases are the most dangerous. Low temperature, foggy weather, cloudy sky is harmful to potato. Late blight infection in become higher in this condition. Contact fungicides should be applied properly to protect the potato crop from this condition.

(b) Cut worm: The larvae of this insect are the main harmful insect for potato. They cut the plant and attack potato.

- At early morning, the plants which are found cut, the soil from the base of these plants should be removed and the larvae should be damaged.
- If the infestation become very higher, it is necessary to apply insecticides in concern with the agriculture officer.

Crop harvesting and take care: 85- 90 days is required for crop maturity in modern varieties. Irrigation supply should be stopped 10 days before harvesting in seed potato.

(a) Hulm pulling: Pulling above ground plant parts of potato is called hulm pulling. Hulm pulling is done 7- 10 days before potato collection. In this operation, the potato plants will be uprooted along with whole root system but the potato tuber will remain under the soil. Consequently, potato skin becomes hard, disease spreading from diseased plants becomes lower and increases storage quality of potato. Seed potato must require hulm pulling but hulm pulling does not require for food potato.

(b) Lifting potato: It is the best to bring the potato tuber home just after lifting. Potato tuber must not be kept in the field making heap after lifting. Because, if the potato tuber is kept open in field, it may be attacked by various diseases and insects (e.g., - potato worm can lay eggs).

(c) Potato storage: The cut, spotted and rotten potato tubers should be separated bringing them home just after lifting. Thereafter these should be kept spread on the floor for 7- 10 days. Then the spotted and rotten potato tuber should be separated again. Thereafter the good tubers should be kept in bags and sent to the cold storage for storing.

Besides this, there are some other methods of production of seed potato. For example:

- (a) Tissue culture method
- (b) Sprout and top shoot method
- (c) Seed potato production without tillage
- (d) True potato seed production

Importance of crop seed: Crop seed is very important in crop production. The crops of which production is possible only by seed; there is no alternative of them to maintain their generation. Besides-

- 1) Crop seed is the basic input for crop production.
- 2) Crop seeds are used as food for men and feed for livestock and poultry.
- 3) Pure crop seed prevents dispersal of diseases, insects and weeds.
- 4) Crop production of improved varieties is possible by crop seed.
- 5) Plant generation is maintained by crop seed.
- 6) Some crop seeds are used as medicine.
- 7) Crop seeds are used as raw materials for many industries.

Importance of propagating materials: Propagation of most of the crops is not possible by seed; though possible, cannot get yield after a long duration. Therefore, to get rapid production from the crop in a populous country, there is no alternative of propagating materials or agronomic seeds. Since the plant root, stem, branch, leaf, bud etc. are used here maternal characteristics are maintained. More that varieties can be added in a single plant. For example, sweet and sour jujube in a single jujube plant; blooming red, yellow, black and white flower in a single rose plant are possible. Besides, using this material, it is possible to protect crop plants from seed- borne diseases. Flowers and fruits can be got using this material in short time and low cost. Therefore, propagating materials are very important.

Task: Learners will collect crop seed in agricultural production and will write down the description in note book.

Section- 2

Fish Pond

Pond is a small and shallow stagnant water body, where fishes can be cultured in a controlled way and if necessary, it can be dried out completely. In a word, pond is the living space of cultivable fish. Pond water remains in stagnant condition, but a little bit waves can be created through air flow. The volume of the pond may be several decimals to several acres. But small and medium ponds are easy to manage and maintaining and also high productive.

Characteristics of an ideal pond:

Fish pond should have some characteristics which can play role to make cultivation profitable. An ideal fish pond should have the following characteristics-

1. Pond should be flood free. For this reason, bank of the pond should be high enough.
2. It will be the best if the pond contains loam, silt loam or clay loam soil.
3. The pond is more suitable where water remains for all the year round.
4. Depth of the pond water should be preferably 0.75-2 meter.
5. It would be better if the pond is in open place and no trees will be available on the bank. Thus, the pond will get sufficient light and air. So, more photosynthesis will be occurred and more food for fish will be produced. Sufficient oxygen will be dissolved in water. North-south sided pond will get more sunlight.
6. Excess mud should not be at the bottom of the pond. The depth of the mud should not exceed 20-25 cm.
7. Management will be easier if the pond area is 20-25 decimal. It is better to have the rectangular shape of the pond. It makes easy for fishing through netting.
8. It is better, if the banks of the pond are sloppy at 1:2 ratio. Therefore, height between the bottom and the bank of the pond will be the two fold distance between the banks and the place where it is to be merged with the bottom getting sloppy.

Properties of the pond water:

For living, feed intake and satisfactory growth of the fishes, pond water quality should be favourable. Properties of pond water can be divided into two groups. 1) Physical properties 2) Chemical properties. Effects of these properties on fish culture are described shortly-

1. Physical properties:

- A) Depth:** If the pond depth is more, sunlight cannot enter through the pond water in more deep level. As a result, in deep area of pond, phytoplankton which is the natural food of the fishes does not generate. Again, it causes the deficiency of oxygen. On the other hand, if the pond is not deep, the water will be extremely hot

in the summer. For this reason, this causes harm to fish and hamper the production.

- b. Temperature:** Fish growth depends on increasing temperature. For example, fish growth decreases in winter. That's why fertilizer and feed application should be reduced in the winter. Rui types of fishes grow best at 25-30°C.
- c. Turbidity:** If mud water becomes turbid by mud particle in the pond, sunlight can not pass through. For this reason, natural food of the fishes can not be produced.
- d. Sunlight:** More photosynthesis occurs in the pond where sunlight falls more. As a result, phytoplankton grows more and fish production is increased

Chemical Properties:

a. Dissolved Oxygen:

Dissolved oxygen in pond water is very important for fish cultivation. Mainly oxygen produced by phytoplankton and aquatic plants in photosynthesis process, are dissolved in pond water. Some oxygen gets mixed directly in the upper layer of the pond water from atmosphere. Fishes, aquatic plants and other animals living in the pond do their respiration activities by these oxygen. At night, no oxygen is produced because photosynthesis does not occur for want of sunlight. For this, oxygen reduces in the morning and increases at afternoon in the pond. For fish cultivation, the amount of oxygen should be at least 5mg/litre (5 ppm or 5 parts per million) in pond.

- b. Dissolved carbon dioxide:** For producing natural fish food: phytoplankton, sufficient amount of carbon dioxide is needed in the pond. But excess carbon dioxide is harmful for fish. If the level of carbon dioxide remains below 12mg/litre (12ppm) in water, it is not poisonous for fishes and shrimps. It is required to remain 1-2 ppm carbon dioxide in pond water for good fish production.
- c. PH:** It would be better to remain PH of the pond water between 6.5 and 8.0 for fish cultivation. If the PH is below 6.5, then fish growth reduces. PH value below 4 or above 11 causes death to the fishes. If PH goes down, lime (1-2kg/acre) should be applied. If alkalinity rises in the pond, ammonium sulfate or tamarind mixed water can be applied.
- d. Phosphorus:** A little amount of phosphorus remains in natural water. This phosphorus turns into phosphate. A lot of phytoplankton grow in presence of required amount of phosphate.

Pond digging for fish cultivation and preparation:

The foremost thing for fish cultivation is to dig new pond or to prepare the remaining pond cultivable. It is discussed below-

a. Digging new pond: For digging pond in any place, it should be dug maintaining more or less those characteristics which remain in an ideal pond. The pond should be dug to keep more or less rectangular. The pond depth should be maintained as if it contains water up to 1.5 to 2 meters in a year. During digging, slope of the pond bank should be kept at least 1.5:2 ratio. If sand is more in soil it would be safe to keep 1:3. Otherwise, it would be useless by damaging pond bank within few days. If soil is well and fertile, then it would be kept separately at the digging time. After digging, this soil should be spread on the sand-soil in the bottom. By this way, water holding capacity and productivity would be increased. It would be better if the width of the above part of the pond bank remains 2.5 meter. Space should be given between upper surfaced layer and bank. This place is called bokchor. The bottom is leveled but should be kept slightly slant. It will make easy to give irrigation water and fish collection. After digging of new pond, the soil of the bank should be made compact by beating with dormuj and grass should be cultivated on bank. This reduces the breaking of the bank and the soil will not be eroded in rainy season.

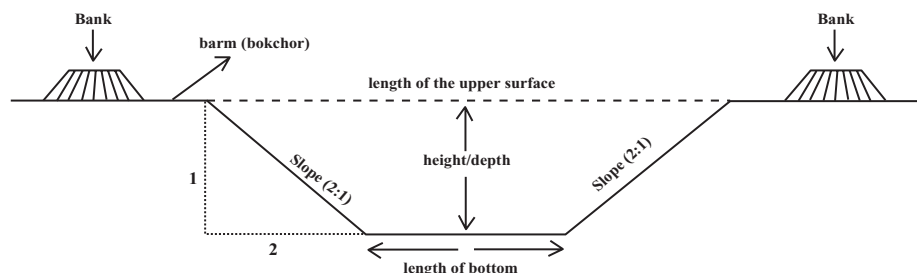


Fig. Cross section of a pond

Pond preparation or making suitable for fish cultivation:

Pond preparation is very important for fish culture. Before fish cultivation, if remaining pond is to be well prepared by digging, fishes can get healthy environment to live. This increases fish growth rapidly and reduces diseases. So, fish production can be profitable. Pond preparation process is to be completed by several sequential steps. The steps are given below-

1. Repairing bank and bottom of the pond:

If pond bank remains broken, the fishes can be flooded away or predators can enter into the pond in the rainy season or in heavy rainfall. So bank should be repaired and raised if it is broken. No big tree should be available in the bank or if remains it should be pruned. By this, the pond will get sunlight and natural food can be produced. If the pond is old, excess mud can be stored at the bottom. In this condition, excess mud should be removed allowing for keeping only 20-25cm. It can be done easily by drying up the pond. Fish pond should be dried up once in every 3-4

years after. After drying, the bottom should be made cracked by scorching sunlight. If possible, ploughing can be done at the bottom. It will remove all the toxic gases, harmful bacteria and insects and keep the pond environment well. After that, bottom of the pond should be leveled. It would be better if one side of the bottom remains slight sloppy. This facilitates to collect fish and pull net.

2. Removal of aquatic weeds:

If different types of weeds like water hyacinth, khudi hyacinth, helencha, kolmilata, algae etc. remain on the bank or in the pond, they should be removed out. The weeds absorb the fertilizers given in the pond, protect sunlight and also inhibit the natural movement of the fishes. The enemies of the fishes like predator fish, snake, frog etc. hide themselves in the weeds and catch the fish to be fed. Weeds can be controlled by using different types of chemicals like copper sulfate or blue vitriol, symazin etc. But it is not expected to use chemical materials. Grass carp, shwarpunti are herbivorous fish. By releasing these fishes at the cultivation period, fish can be controlled by organic method

3. Removal of predator and uncultivable fish: Shol, boal, chitol, foli, taki, gojar etc. directly eat the cultivable fish. Besides, punti, chapila, chanda etc. are uncultivable fish. They share space, food and oxygen of the cultivable fish. As a result the production of the cultivable fish decreases. The predator and uncultivable fish can be removed in any of the following process-

- a. By Drying out the pond:** After drying out whole water of the pond, all the fishes can be collected. Many fishes can hide themselves in the mud of the bottom. So the pond should be well-dried in the sun.
- b. By netting:** When pond contains less water, fishes can be collected out by netting repeatedly.
- c. By using baits:** In this case Rotenon or Mahua cake can be used. The fishes killed by these are eatable. These materials block the hole of the fish gill. Thus, fish dies by suffocating. 30-35g Rotenon or 3 kg cake of Mahua can be used per decimal in pond water with 1 feet or 30 cm depth. For this, total amount should be divided into three parts. Small balls from making paste by the one part should be spread over the pond. Another two parts should be spread over by dissolving them in water. After that the water should be stirred by netting. Fishes should be harvested by netting when fish floating on the water. Pond water can not be used up to 7-10 days of poison application and new fish can not be released. But fishes killed by Rotenon should be eatable. Different toxic materials can be used for killing the fishes in pond like- Phostoxin tablet. It is not wise to kill fish with chemical materials.

4. Application of Lime

After drying out, lime should be applied at the bottom of the pond. If the bottom of the pond is ploughed, lime should be applied at that time. If water remains in the pond, lime can be spread all over the pond by dissolving it in the aluminium bucket or drum after cooling.

Usefulness of lime application:

1. Lime increases the fertility of water and soil. 2. Maintains the PH of water. 3. Reduces the turbidity and keep water clean. 4. Destroy germs of fish diseases. 5. Increase the efficacy of fertilizer.

The dose of lime application depends on the types of the bottom soil of pond, pond age and PH of water. For example, lime dose should be a little bit more in clay soil, mud soil and red soil in pond.

Here the doses of lime application on the basis of pH value of the soil are given below:

Doses of lime application during pond preparation

PH value of water	Dose of lime stone (Kg/hectare)	Dose of normal application
3-5	12	Generally 1-2 kg lime for per decimal area is applied in our country.
5-6	8	
6-7	2	

5. **Application of Fertilizer:** Natural food for fish produces by fertilizer application. The main natural food of the fishes are phytoplankton and zooplankton. Different nutrient elements like phosphorus, potassium can be mixed up with water by applying fertilizer in pond. Phytoplankton grows in the water utilizing these nutrients. And depending on the phytoplankton, zooplankton produces. There are two types of fertilizers, such as- a. Organic fertilizer like cow dung, faeces of the poultry birds, b. Inorganic fertilizer like urea, TSP, MP etc. The fertilizer should be applied after 5-7 days of lime application. The fertilizer should be applied within the time between morning and noon at a sunny day. After dissolving, fertilizer should be spread equally all over the pond.

Doses of fertilizer application on the pond:

Organic fertilizer		Inorganic fertilizer	
Name of fertilizer	Dose(Per decimal)	Name of fertilizer	Dose(Per decimal)
Cowdung	5-7 kg	Urea	100-150g
Or		TSP	50-75g
Excreta of poultry birds	3-4 kg	MP	20g

6. **Testing Natural Food:** Before stocking fries in the pond, testing should be done whether natural food for fish in the pond is produced or not after 5-7 days of fertilizer application. It can be done by several methods.

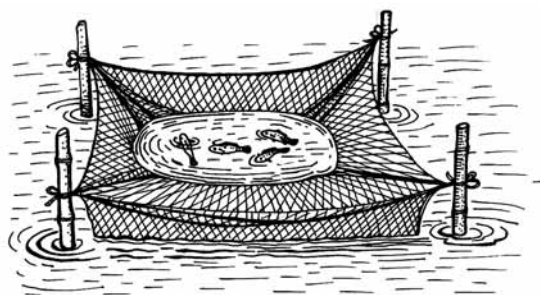
- a. **Secchi disk:** After dipping a black and white tin plate with 20 cm diameter (it is called Secchi disk) with the help of rope and if the plate is not seen in 25-30 cm depth of water then it should be understood that there are natural food available in the pond. If secchi disk can be seen more than 30 cm depth, then it can be understood that there is low amount of food.
- b. **Testing with hand:** After dipping the hand up to elbow and if the palm can not be visible in the water then it should be understood that there are optimum food.
- c. **Testing with glass:** Taking pond water in a transparent glass and holding it against the sunlight, and if the green or brownish green water or many small particles and small insects can be seen, it is to be understood that there are optimum natural foods.

If the fish food is not produced yet after testing, then one should be waiting for 3-4 days. If yet not produced, fertilizer should be applied again.



Fig. Testing with secchi disk and glass

7. Testing toxicity of water: Before 1 day of stocking fries, "Hapa" should be placed in a pond where fishes are killed by using chemical poison. 10-15 fries are released and kept in the hapa or in that pond water keeping in bucket or pot for 24 hours. If any fish does not die by this time, it is to be seemed that there is no toxicity in pond water. Then the fries should be released.



Testing toxicity of water

Task: Learners will test if there is enough natural food in the nearer pond along with the teacher and submit it after writing in a note book.

Releasing method of fish fries in pond:

For releasing in pond, fish fries can be collected from any nearer government or non-government hatchery or nursery farm. The fries can be transported with earthen pot or aluminium pot when the distance is short. But in case of far distance, the fries should be transported by polythene bag with supplying oxygen. In this case, the fries should be carried in a polythene bag maintaining one third part of water and two third parts of oxygen. The fries should not be released directly in the pond. Before releasing, the fries should be adapted with the pond water. For this, the poly bag or pot containing fries should be floated on the pond water for 15-20 minutes. In this time, pond water should be gradually mixed in the polythene bag or pot. By this, temperature of pot and poly bag will be almost equal. After that the waves of the pond water should gradually be allowed to enter into the poly bag or the container by tilting it slowly and thus the fries will be moved out themselves towards the pond water. The fries should be released in the morning or afternoon or cool weather of the day. If fries are purified before releasing, they will be relieved even they are infected by harmful parasites. This also reduces the possibility of disease infection and risk of death. Every time, 300-500 fries should be washed for half minute with a solution containing one tea spoon potassium permanganate or 200g salt in ten litres of water taking in bucket or pot. Solution prepared once can be used 4-5 times for fry purification. So, quantity of fries should be released according to pond space.



Fig. Method for releasing fish fries

New words: PPM, Rotenon, Phostoxin tablet, Secchi disk

Task: Learners will prepare a report and represent it after visiting pond/ fish farm.

Section- 3

Types and Different Layers of the Pond

Types of pond:

The ponds can be divided into different parts on the basis of water holding capacity, types of fish in pond and area of pond etc. The main classifications of pond are discussed below:

1. Classification on the basis of durability of water:

- A) Permanent or annual pond:** In these ponds water remains all the year round. These are very deep. Their soil always can hold water such as pond of clay soil and loam soil. Indigenous carp fishes like rui, katla, mrigel, carpio etc, mixed culture of shrimp and carp fishes can be cultivated as mixed culture in these pond.
- B) Temporary or seasonal pond:** In these ponds water remains in specific time of year (3-8 months). These ponds are not so deep. Soils of these ponds can not hold water for more time such as pond of sandy soil. In these ponds, fast growing fishes which are suitable for marketing in less than one year can be cultured. For example, silver carp, tilapia, shwarpunti, shing, magur etc.

2. Classification on the basis of age of the cultivated fish:

The fish fries can be divided into different stages according to age and length. Like yolk sac larvae, larvae (renu fry), fry (dhani) and fingerling. The stage after egg hatching is known as yolk sac larvae. They have a sac below their stomach. In this situation (2-3 days) they don't take any food from outside. The stage after finishing the yolk sac is known as larvae (renu fry). When renu fry grows consequently and becomes shape of rice grain (like 2 or more than 2cm), are called dhani fry and when longer as finger (more than 7 cm) is known as fingerling. For rearing these different types of fry, ponds of different environment are needed. Their description is given below:

A) Nursery pond: The pond where larvae (renu fries) are released and grown up to dhany fries is known as nursery pond. Here 50-100g renu fries are released per decimal and cultured for 15-30 days.

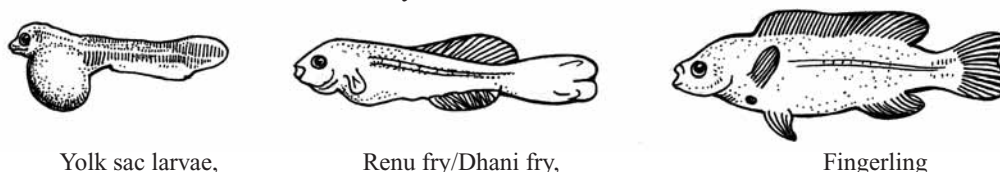


Fig: Different stages of fry

B) Rearing pond: The pond where dhani fries are released and grown up to fingerling is called rearing pond. The area of rearing pond may be 20 to 100 decimal and depth may be 1.5-2 meters. In this pond, dhani fries can be cultured for 2-3 months after releasing 2500-4000 fries per decimal.

C) Stocking pond: This is the main pond for fish culture. The pond where fingerlings are released and grown up to adult fish is called stocking pond. The area of this pond is more than 30 decimal and depth 2-3 meters. Generally, fish should not be cultured here more than one year. Because, growth rate become slower even provided feed.

Moreover, the ponds can be divided according to its area. Such as, mini pond or small pond (1-5 decimal), medium pond (10-30 decimal) and large pond (more than 30 decimal).

Different layers of pond:

Changes of temperature, oxygen, and plankton occur due to varying depth of the pond water. Different fishes roaming in the pond also live in different depth and take food. The pond can be divided into three layers according to these differences like-1. upper layer, 2. middle layer and 3. bottom layer.

- 1) **Upper layer:** Though the upper layer of the pond remains close to the air, large amount of oxygen remains in this layer. Upper layer contains more phytoplankton which is used as fish feed. Shwarpunti, katla, silver carp, and big head carp stay in this layer and take food.
- 2) **Middle Layer:** In this layer, temperature and dissolved oxygen remain lower than the upper layer. Phytoplankton and zooplankton both can be available in this layer. Rui fish lives and take foods in this layer.
- 3) **Bottom Layer:** In this layer, lowest level of dissolved oxygen and temperature remain. Zooplankton, insects, decomposed wastes, earth worms, snails-oysters are available in the bottom of pond. Mrigel, kalabaush, carpio or common carp, shrimp, pangash, shing, magur live and take food in this layer.

There are some fishes which roam in all layers like tilapia. On the other hand, grass carp takes green plants as food growing on surface, bank or bottom of the pond.

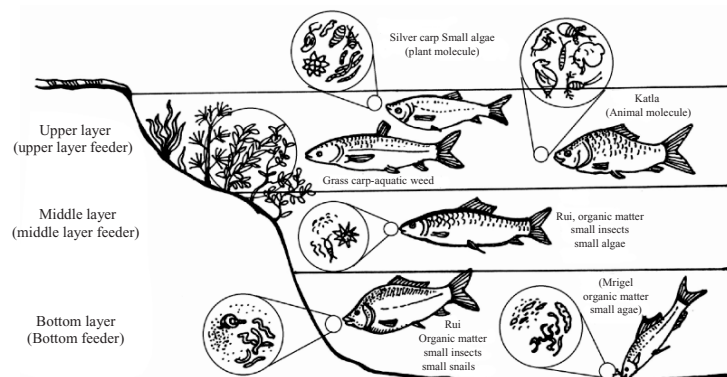


Fig. Different layers of pond

Task: Learners being divided into several groups will represent poster in the class on location of the fishes in different layers and their food habit.

New words: Nursery pond, rearing pond, stocking pond, annual or seasonal pond.

Animal group living in ponds:

Animals living in the pond can be divided into four parts on the basis of living place. Such as-

- 1) Plankton:** Plankton is a microscopic animal floating freely in water. They are of two types like phytoplankton or plant molecule and zooplankton or animal molecule. If pond water becomes green or greenish then it would be understood that phytoplankton remains in water. Phytoplankton is also known as one celled algae. Some examples of phytoplankton are- chlorella, anabaena, microcystis etc. And some remarkable zooplankton are daphnia, copepod, rotifer. If water colour becomes brownish green, reddish green, or yellowish green, it can be understood that the amount of zooplankton is also good along with phytoplankton. For producing plankton in pond, regular fertilizer should be applied by maintaining sufficient air and light. Organic and inorganic both types of fertilizers can be used.

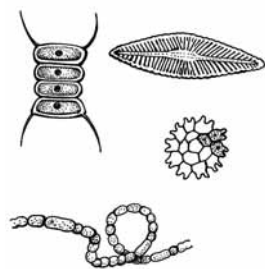


Fig. several phytoplankton

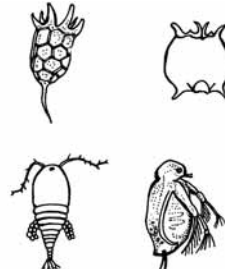
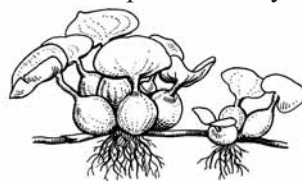


Fig. several zooplankton

- 2) Swimmer or nekton:** they can swim freely. They move around the whole water and takes food by searching like fish, frog etc. although the traits of their egg and larva are as like as plankton.
- 3) Bottom living organism or benthos:** The organisms remain on or in the mud of the bottom of the pond are called bottom living organism or benthos. Such as- decomposing bacteria, snails, oysters etc. Bottom living animal helps to release nutrient element of plankton- nitrogen and phosphorus from bottom layer of the pond. As a result nutrient element of the plankton increases which is good for fish culture.
- 4. Aquatic plants:** Different aquatic plants grow in pond. Such as-
- A) Algae:** Different types of algae grow at bottom area or bank of the shallow pond. Such as- Spirogyra, Chara etc.
- B) Floating plant:** These plants float on water. The roots of these plants are not attached with soil. For example- Water hyacinth, topa hyacinth, khudi hyacinth etc.



Water hyacinth



khudi hyacinth

Fig. Several aquatic floating plants

- C) Submerged plant:** The roots of this plant remain under the water but leaves and upper part of stem or only leaves stand on or float on the water. Such as- water lily, water chestnut, sushni shak, arail.



Water lily

lotus

Fig. Several submerged plants

- D) Merged plant:** These types of aquatic plants remain at the bottom of the pond. The roots of these plants remain attached with soil. The leaves and branches never come on the water. Such as- Jhanjhi, spiny algae, najas.



Fig. Several merged plants

- E) Creeper plant:** The roots of these plants remain attached with the bank of pond and stem, leaves spread on the water like- halencha, kolmilata, maloncho.



Fig. Several creeper plants

Section- 4

Sanctuary of Fishes

There are various types small, big internal water bodies in the riverine country of our Bangladesh which area is about 47 lakhs hectare and moreover, it has immense Bay of Bengal of 1.66 lakh square kilometers. Among the water bodies in Bangladesh, 88 percent is free water body like- river, beel, water body of Sundarbans, kaptai lake, haor, tidal area containing 40.25 lakhs hectare area. On the other hand, closed water bodies are only 12 percent, among which pond, lake, ditch, haor and shrimp farm. The total area of these is 6.78 lakh hectare. Presently in Bangladesh, 80 percent of total

fish production comes from internal water bodies, 20 percent fish comes from sea. In long past, various types of huge fishes were caught in natural internal water bodies of this country. It was 80 percent of total fish production in 60th decades. The production from internal water body has come down to 35% in last few decades for increasing population, excess usage of water, rough usage of pesticides in agriculture, water pollution for industrialization, excess fish collection, unnecessarily killing of brood fish and fries, unplanned construction of groyne and infrastructure and unbalancing environment. Rest 47% production comes from the fishes cultured in different closed water bodies and 18% comes from sea fishes. Not only the production but also biodiversity of fishes is reducing day by day in free water bodies. By this time, among the 260 species of sweet water fishes of Bangladesh, 12 critically endangered, 28 endangered and 14 threatened species have been identified. The species which are facing the risk for extinction within short time from the natural water bodies are called critically endangered species (as shwarpunti, mahashol, baghair), and the species which are facing the risk for extinction in immediate future are called endangered species. On the other hand, the species which are not yet extinct, but have the chance to extinct in medium term, are called threatened species. Some example of the endangered fish species of Bangladesh are rani, pabda, tengra etc. And threatened species are foli, gulsha, kajli, meni etc. For increasing fish production and conserving biodiversity in free water bodies, it is very important to establish secured living place or sanctuary for fishes. Fish sanctuary is any water body or its specific area like haor, beel or any portion of river where fishing is banned for a specific time of a year, or for all the year round or long term or permanently. Sometimes, tree branches, bamboo etc. are placed in those areas for restriction of fishing. Hence, fish gets safe shelter, can roam and bred freely. Presently, about 500 safe shelters have been maintained in different rivers and internal free water bodies.

Importance of establishment of fish sanctuary:

1. By establishing or announcing fish sanctuary, safe living place of fishes can be ensured.
2. Free breeding and tidal area can be conserved and extent.
3. By creating safe shelter, nearly extinct or endangered species can be conserved.
4. By ensuring sufficient natural foods for fish growth.
5. Reproduction and stocking can be increased by protecting mature fish.
6. Fish biodiversity can be conserved in aquatic environment.
7. Increasing fish production in free water bodies plays role in our food security.



Fig: Fish sanctuary

Task: Learners being divided into several groups will represent poster in the class on location of the fishes in different layers and their food habit.

New words: Critically endangered species, endangered species, threatened species, internal free water body.

Section- 5

Fisheries Conservation Act

Fisheries conservation act:

The population of our country is increasing day by day and at the same time, the demand of fishes is also increasing. For increasing the demand, the fishermen are fishing almost all fishes with various sizes from the different water bodies of the country. Fries and adult fish are not getting rid of this also. As a result, fish production is gradually decreasing from the natural water bodies and even some species are getting lost. In 1950, government legislated "protection and conservation of fish act-1950" by applying several ordinance on fish size, breeding and growth period, place for strolling so that fish production and biodiversity does not decrease rather than it increases or be in an acceptable state. It is commonly known as "fishery conservation act". Subsequently, this law was corrected, amalgamated and refined in different times for real need. The remarkable ordinance of this law are-

1. Without the view of cultivation, **a)** Every year, from July to December (mid Ashar to mid Poush) the katla, rui, mrigel, kalabaush, ghania fishes with below 23 cm (9 inch) in size; **b)** Every year from November to May (mid Kartik to mid Jaistho) hilsha fish with below 23 cm in size (which is known as jatka); **c)** Every year from November to April (mid Kartik to mid Baishakh), pangash fish with below 23 cm (9 inch) in size; **d)** Every year from February to June (mid Magh to mid Ashar), sylon, boal and air fish with less than 30 cm (12 inch) in size are prohibited to catch, possession, transport and sell by anybody.
2. Without the view of cultivation, every year from 1st April to 31st August (mid Chaitro-mid Vadro), no steps can be taken for fishing or destroying the fries or couple fish of shoal, gajar, taki in the water bodies connected with rivers, canals, beels.
3. No temporary or permanent groyne or any kind of infrastructure can be constructed on the rivers, canals and beel without the purpose for irrigation, flood control or making drain.
4. No fish can be caught by permanent architecture (fixed engine) making in rivers, canals. In this case, permanent architecture can be removed or confiscated.
5. No steps can be taken for destroying fishes in internal water bodies by applying poison, environmental pollution, industrial wastes or any other way.

6. For catching fish, trap net (usual name: current jal) having the trap of 4.5 cm or less diameter or length is prohibited to be used.
7. **Conservation of hilsha sanctuary:** In government announced 4 hilsha sanctuary area, every year from March to April, nobody can catch or creating the cause for catching fish in the area from Shatnol of Chandpur district to Char alexander of Luxmipur district containing 100 kilometer area of Meghna river; from Madanpur/Char hilsha to Char Pial of Bhola district containing 90 kilometer area of the Shahbajpur branch of Meghna river; from Bheduria of Bhola district to Char Rustum of Patuakhali district containing about 100 kilometer area of Tetulia river; and every year, from November to January, nobody can catch or creating the cause for catching fish in the area from Kalapara upazilla of Patuakhali district containing 40 kilometers area of Andharmanik river.
8. **Conservation hilsha fish in their breeding place:** For giving the free breeding opportunity, every year from 15 to 24 October (1-10 Aswin), catching of hilsha fish is prohibited in 7000 square kilometers area including Shaherkhali/Haitkandi point of Mirshorai upazilla in Chittagong district; Tajumuddin/Poshchik Saiyod Aulia point of Tajumuddin upazilla in Bhola district; north Kutubdia/Gondamara point of Kutubdia upazilla in Cox'sbazar district and Latachapali point of Kalapara upazilla in Patuakhali district.
9. **Punishment:** a) For first time defaulter of law, the punishment would be at least 1 month to highest 6 month rigorous imprisonment and maximum fine of Tk. 1000.00 with it. b) Next, for defaulting of law every time at least 2 month to maximum 1 year rigorous imprisonment and maximum fine of Tk. 2000.00 with it.

New Words: Jatka, Current Jal.

Section- 6

Housing of Domestic Bird

Housing of Chicken & Duck

Small shed or house is made for sheltering birds only at night in household level if reared 10-15 birds. But housing is required for bird if reared with modern farming systems. Housing for birds should be made for the following objectives-

- | | |
|-------------------------------------|---|
| 1. To make comfortable environment. | 5. To supply feed and water easily. |
| 2. To manage properly. | 6. To prevent and control of poultry disease. |
| 3. For intensive care. | 7. For easy vaccination. |
| 4. To prevent from bad weather. | 8. To protect from wild animals. |

9. To protect from thief.

11. For cleaning litter easily.

10. To collect egg easily.

12. To require less labour.

Steps for making housing for poultry:

1. Site selection for housing.
2. Design selection for house.
3. Planning for making different types of houses for poultry.
4. Making house.
5. Providing sufficient space for poultry.

Task:

Learners will write down the steps for making house for poultry and represent it in their class.

Site selection for housing of poultry: Housing of poultry should be done in place where following advantages will be available. Such as-

1. High and flood free area.
2. Far from market, high way and community.
3. Facilities for egg and meat marketing.
4. Good communication.
5. Well supply of electricity and water.
6. Good drainage system.
7. Scope for extension of farm in future.

Design of house

Rectangular house is better for poultry. Length of the house depends on birds number. Length of house is variable but width should be within 4.5 to 9.0 meter. Poultry house should be east-west long and opened in the south. House can be two types on the basis of roof design. Such as-

1. Shed type
2. Gable type

Shed Type: Shed type or single roofed house can easily be made. This type of house is more suitable for rearing birds in open or semi intensive system.

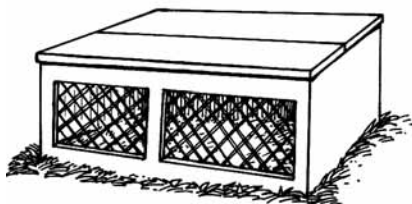


Fig: Shed type house



Fig: Gable type house

Gable type: Gable type or double roofed house requires more cost for making. Roof of this type of house is sloppy. This house is more suitable for the area where rainfall is more.

In any of the design, house should be the following categories for rearing birds with different objectives. Such as-

1. **Chick or brooder house:** In this house, from newly hatched chicks to 4-6 weeks aged birds are reared and provided artificially heat, vaccines, litter, feed and water.
2. **Grower house for growing birds:** In this house, egg producing birds are reared from 5/7 weeks to 20 weeks of age.
3. **House for laying birds:** Egg producing birds are reared from 21 weeks to 72 weeks.

Hatchery: Hatchery is a farm from where chicks can be obtained from incubator through incubation of fertile eggs.

Broiler house: The farm where meat producing broilers are reared is called broiler farm and the house where broilers are reared is called broiler house. In broiler house, birds are reared up to 4-6 weeks.

Preparation of house

Roof: Tin, asbestos and corrugated sheets are used for making roof. But roof made of cement or concrete is better for commercial purpose. In rural condition, straw or suitable tree leaves can be used for household poultry farm.

Floor: It is wise to keep floor dry, birds are reared on concrete floor or slat.

Wall: Wall of bird's house can be made of soil, bamboo, wood, brick, wire net etc. Wall height should be 0.3 meter (1 foot) for broiler and 0.6 meter (2 feet) for layer and the wire net can be fixed in upper portion of wall. But in winter, this upper portion with wire net should be covered with gunny bag or tarpaulin.

Door: Door of poultry house should be opened at south and it should be large in size.

Space requirement for poultry: In poultry house, enough space should be provided to birds. Space requirement of poultry according to their age is given below.

Age (month)	Required space for each bird (Square meter)		
	Litter method	Cage method	Slat method
0-1	0.05	0.02	0.02
1-2	0.14	0.03	0.03
2-3	0.19	0.05	0.05
3-4	0.23	0.05	0.10
Aged bird	0.28	0.07	0.19

New words: Housing, shed type house, gable type house and hatchery.

Section- 7

Poultry Feeding

Feeding is required for growth, maintenance, production. Grains and their by products are used for poultry as feed. 70% of total cost is required for purchasing feed for poultry farm management. Characteristics of feed are discussed below.

1. Grains and their by products should be fresh and good quality.
2. Poultry feed should contain necessary nutrients.
3. Feed should be free from microorganisms, fungus and parasites.
4. Feed should be formulated by various ingredients.
5. Feed should be easily digestible.
6. Feed should be very palatable.
7. Feed production cost should be less.

8. Feed should be free from any offensive odour.
9. Feed ingredients should be easily available.



Fig: Fish meal

Poultry feed ration can be prepared by mixing with several feed ingredients. Ration may be defined as the feed which is intake by birds within 24 hours. Ration must be nutritionally balanced. When a ration contains carbohydrate, protein, fat, mineral and salt as the bird's requirement is called balanced ration. The functions of balanced ration are given below.

1. Feed helps for living
2. It supplies energy.
3. Feed helps for body growth.
4. It helps for bone formation in body.
5. It repairs cell damage and maintains growth.
6. It keeps water balance of the body.
7. It helps to produce blood in the body.
8. It prevents the disease of the body.
9. It helps to produce eggs and meat.



Fig: Oystershell

Feed for chicken

As chicken is reared for the production of eggs and meat, so, separate ration should be prepared for layer chicken (for egg) and broiler chicken (for meat). The name of three types of ration for layer chicken is given below:

1. Layer- starter ration: 0-8 weeks
2. Layer- grower ration: 9-19 weeks
3. Layer- layer ration: 20-72 weeks

3 types of ration are provided to broiler chicken

1. Broiler starter ration: 0-2 weeks
2. Broiler grower ration: 3-4 weeks
3. Broiler finisher ration: 5-6 weeks

Feed ingredients: Mainly grains and their by products are used for preparation of poultry feed. Wheat, corn, and bran are used as grains for ration formulation. But some cereal grains like rice with husk, rice, broken rice, pulse, mustard etc are provided to birds in household farm. Feed ingredients should be selected for ration formulation by considering its nutritional value, availability and market price. A chart for feed ingredients by considering its nutritional elements is given below:

Nutritional elements	Feed Ingredients
Carbohydrate	Wheat, corn, rice with husk, rice, broken rice, wheat bran etc.
Protein	Fish meal, sesame oil cake, mustard oil cake, soybean meal, blood meal etc.
Fat	Various vegetables oil: Palm oil, sesame oil, soybean oil, etc.
Mineral	Common salt, oyster shell, bone meal, egg shell
Vitamin	Vegetables, vitamin mineral premix etc.
Water	Clean, fresh and organisms free water.

Feed intake by chicken: Feed intake of layer and broiler depends on chicken breed, age, temperature, quality of feed, housing, feed particle size and supply.

Age	Chicken (g/day)	Broiler (g/day)
First week	10	25
Second week	20	65
Third week	25	100
Fourth week	30	130
Fifth week	35	160
Sixth week	37	165
Seventh week	40	----
Eighth week	45	----
Growing	70	----
Aged	115	----

Task: Learners individually will calculate 7 days ration for 100 growing layer birds and represent it in the class.

Methods of ration formulation

At first, wheat or corns will be broken in a mill. Oil cake will also be grinded. A balance for weighing feed ingredients will be used. Ration making area should be neat & clean. First, wheat or corns will be placed on the floor after weighing. After that finely grinded rice, wheat bran, fish meal, oil cake, soybean oil will be placed gradually one after another. After placing all ingredients on the floor, the stack will be looked like a pyramid. Oyster shell, bone meal and salt will be spread on the pyramid. After that vitamin mineral premix will be properly mixed with half kilogram feed separated from stack and the mixed feed with vitamin mineral premix will be placed on the stack. If soybean oil is required to add, it will be added around the pyramid. After that all ingredients will be mixed properly by inserting hands repeatedly into the pyramid. This mixed feed will be looked like brown colour.

Presently, commercial feed for poultry is available in market. This feed is manufactured in the modern feed mill. On the basis of bird age and purpose, feed with mash (powder form), crumble (grain like), and pellet (pill like) can be purchased from market.

Feed chart for layer chicken of different ages:

Ingredients	Starter ration (%)	Grower ration (%)	Layer ration (%)
wheat/broken corn	52.0	48.0	50.0
Wheat bran	8.0	8.0	6.0
Rice polish	11.0	15.0	15.0
Sesame oil cake	12.0	11.0	8.0
Fish meal	13.0	12.0	12.0
Bone meal	1.5	3.0	2.5
Oyster shell	2.0	2.5	6.0
Common salt	0.5	0.5	0.5
Total	100.0	100.0	100.0

Special note:

1. Vitamin-mineral premix: It should be added in feed as per manufacturer recommendation.
2. Organisms free pure water: Adlibitum

Feed chart for broiler chicken of different ages:

Ingredients	Starter ration (%)	Grower ration (%)
Broken wheat/corn	50	52
Broken rice	15	12
Sesame oil cake	12	10
Fish meal	14	12
Soybean meal	8	9
Soybean oil	-	2
Bone meal	1.5	2.5
Common salt	0.5	0.5
Total	100	100

Task:

Learners individually will formulate a starter ration for 14 days of 100 broiler chickens and represent in the class.

Special note:

1. Vitamin-mineral premix: It should be added in feed as per manufacturer recommendation.
2. Organisms free pure water: Adlibitum.

New words: Starter ration for maintenance, Grower ration, Finisher ration, Layer ration. Mash, crumble and pellet feed.

Duck feed:

Duck is called the aquatic bird. They can live on small aquatic animals and plants of canal, beel, pond, haor and river. Duck can give good production by taking grass and leftover feed. Feed should be provided to duck by mixing with water. Duck like to eat wet feed instead of dry feed. So, Duck should be provided powder form and wet feed. First 8 weeks, duck should be provided sufficient amount of feed. After that, feed should be provided two times in a day-morning and evening. After birth, duck should be fed by hand for first few weeks for teaching them to eat.

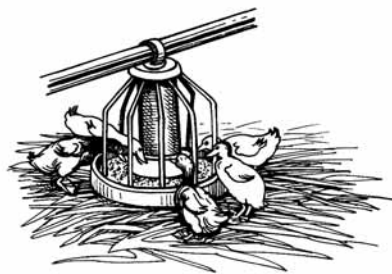


Fig: Ducklings are taking feed



Fig: Giving feed to ducks

Like chicken, duck feed has to be formulated by mixing with various ingredients. The name of 3 types of feed for duck is given below:

1. Chick starter ration: 0-4 weeks
2. Grower duck ration: 5-19 weeks
3. Layer duck ration: 20 weeks- rest.

Duck feed intake: 3 types of ration are supplied to duck according to their age and rearing purpose. Daily feed intake of duck depends on duck breed, age, feed quality, housing, feed particle size and feed supply.

Age	Duck (g/d)
First week	15
Second week	25
Third week	30
Fourth week	35
Fifth week	40
Sixth week	45
Seventh week	50
Eighth week	55
Growing	85
Aged	125

Task:

Learners individually will calculate ration for a duck intake feed up to 20 weeks age and represent it in the class.

Ration for duck of different age

Name of ingredients	Starter ration (%)	Grower ration (%)	Layer ration (%)
Broken corn	50	45	40
Rice polish	18	20	20
Oil cake	16	17	18
Soybean meal	6	7	7
Fish meal	8	8	8
Snail shell	1.5	2.5	6.5
Common salt	0.5	0.5	0.5
Total	100	100	100

Section- 8

Housing for Livestock

Housing means giving shelter to the animal with comfortable environment for living healthy condition and obtaining high production from them. Livestock house may be defined as the comfortable shelter for livestock where they can live, intake feed and take rest. There are many advantages in livestock house. If livestock reared individually or as group in the house, management will be very easy and production cost will be less. It is good for livestock health if allow them frequently to walk around at out side environment rather than keeping in confined condition all times.

Objective of housing

- | | |
|---|---|
| 1. To manage comfortable environment. | 9. To produce more milk and meat from livestock. |
| 2. To give shelter and rest for livestock. | 10. To get milk efficiently. |
| 3. To protect from bad weather. | 11. For easy and proper supply of feed and water. |
| 4. To protect from insects and wild animals | 12. To prevent and control of diseases. |
| 5. To protect from thief. | 13. To provide treatment timely. |
| 6. For individual and intensive care for livestock. | 14. For easy cleaning of livestock house. |
| 7. To make animal docile. | 15. To conserve the cow dung and other waste materials. |
| 8. For proper pregnancy, parturition and calf management. | 16. To reduce the production cost. |

Site selection for livestock housing

Site selection for livestock housing is an important factor. Farm will not be profitable if the site is not selected properly. Livestock housing is related to the capital and livestock number. Livestock housing should be prepared in a place where following advantages are available:

1. High and flood free area.
2. Far from market, highway and community.
3. Facilities for eggs and meat marketing.
4. Good communication system.
5. Facilities for supply of electricity and water.
6. Good farm drainage system.
7. Housing area free from sunlight.
8. Neat & clean around the house.

9. Considering the supply of feed and water.

10. Scope for farm extension in future.

Housing for cattle:

The popular method of housing for cattle is to rear cattle tied in the house. Housing will be single row if cattle number is less than 10 and double row if cattle number is more than 10.



Fig: Cattle housing

Housing for sheep:

Housing for sheep is not so important. Because they graze in the field all day long for feeding. Housing is made for sheep for producing more wool and meat. Three types of housing are used for sheep rearing. Such as,

A. Open or extensive B. Semi-open C. Intensive

House floor may be on ground level or on slat based on the weather or climatic condition.

- A. Open or extensive:** This type of house is more suitable where rainfall is very less. The open house is prepared by fencing around a definite place. This type of house has no roof. A group of sheep take shelter here at night after grazing all day long. Straw is used on the floor.
- B. Semi-open house:** When a place with roof is prepared at the one corner of a definite place of open house is called semi-open or house. Semi-open house can be used in the area where rainfall is not frequent.
- C. Intensive:** This type of house is more suitable in the area where heavy wind and excessive rainfall is common. Intensive house is fully covered by roof. Sufficient light and ventilation should be available in this house. Floor of the house may be concrete or semi-concrete.

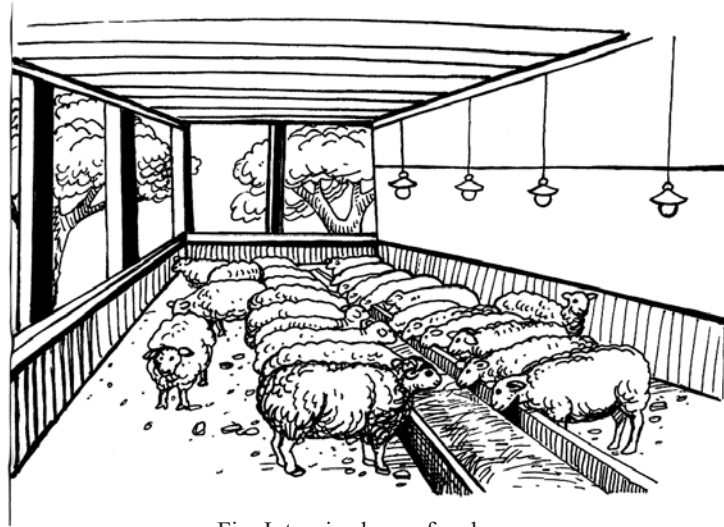


Fig: Intensive house for sheep

New words: Wet feed, leftover, grain, grit mixture

Section- 9

Livestock Feed

Animal essentially requires feed to be alive. The substance which is intake by animal during eating and becomes digested, absorbed, utilized in body by metabolism or produce energy, is known as food or feed. e.g.,- wheat, maize, grass, oilcakes etc.

Traditionally, the livestock feeds are divided into the following two types:

- 1) Roughage feed
- 2) Concentrate feed

Roughage feed:

Roughage feed supplies very high amount of fiber and lower amount of energy. e.g., any straw, natural or cultivated green grasses, hay, silage etc.

Animal can get roughage from pasture or roughage can be supplied to animal by cutting grasses. Comparatively leguminous plants like alfa- alfa, cowpea, grasspea, black gram, ipil- ipil etc. contain much protein, energy, vitamin and minerals than that of normal grasses. Among the normal grasses maize, napier grass, para grass, German

grass etc. are the main. The suitability of these types of grasses that their per hectare production higher than that other grasses.

Concentrate feed:

The feed in which lower amount of fiber and higher amount energy is found is known as concentrate feed. We cannot get expected yield from the milk or meat producing livestock if they are supplied only roughage feed. In that condition, sufficient amount of concentrate feed should be supplied.

The concentrate feeds are divided into the following two types:

- a) Animal sources- fish meal, blood meal, feather meal etc.
- b) Plant sources- wheat, maize, barley, sorghum, broken rice, oilcakes, rice polish, bran etc.

Besides, in livestock feed, oyster shell, egg shell, bone meal etc. are used as minerals; leafy vegetables, vitamin- mineral premix and some antibiotics, hormones as feed additives etc. are used.

The availability of livestock feed varies in Bangladesh based on the seasons. Green grasses are found for a certain period and if these are conserved properly, there will be no insufficiency of green grasses all the year round.

There are two methods of conservation of grasses:

- a) Silage
- b) Hay

Silage

Preservation of green succulent grasses before flowering in air- tight condition is called silage. In that condition, green and succulent grasses are cut into pieces and are preserved. Commercially, silage is preserved in silo- pit. Silage produced from maize, sorghum, alfa- alfa contains higher energy.

Advantages of using silage:

1. Maintains nutritive value for long time.
2. Can supply grasses to livestock as effective feed by cutting them at proper stage.
3. Loss of nutritive value is lower compared to hay.
4. Maximum use of grass land is possible by making silage.
5. Silage can also be prepared in cool and humid weather.

Procedure of silage preparation:

Although silage can be prepared using various types of grasses, silage prepared from maize and alfa- alfa is of highly improved quality. Silage prepared from maize is very suitable for livestock especially for milk- cow. It contains high nutrient elements.

Maize plant is to be cut for silage preparation just after appearing black spot at the base of the maize grain. At this time, maize plant contains 30- 35% dry matter. The maize plants are cut 10- 12 cm above the ground and these plants are cut into pieces. The pieces are preserved in air- tight pits for a long time. But now- a- days, these are preserved in large sized polythene bags instead of pits. The openings of the bag are made air- tight so that the air cannot enter into the bags. By processing this way, nutritive value of grasses can be maintained for a long time and can be supplied to the livestock when necessary.

Objectives of making plant pieces and air- tight during silage preparation:

1. Higher amount of sugar can be released for fermentation.
2. For proper fermentation, necessary lactic acid can be synthesized under air- tight condition.

It is an effective method for preservation of grasses without any nutrient loss. Silage can be effectively used by maintaining nutritive value and protecting infection from harmful yeast, mold, bacteria etc, under air- tight condition.

Hay:

Hay is well known and important storage feed which can be supplied to the livestock all the year round. Hay is prepared from green grasses by drying and lowering its moisture content at 20% or below. One or more leguminous crops can be cultivated to prepare hay. Leguminous plants generally contain higher amount of protein, vitamins and minerals compared to other normal grasses. The bacteria *Rhizobium*, present in the nodules of leguminous plants, fix atmospheric nitrogen which is used in protein synthesis. Beside legumes, normal grasses can also be used to prepare hay.

Characteristics of quality hay:

Feed value of hay depends on the quality of grasses. The quality of hay is evaluated by the maturity of grasses, amount of leaves, colour of grasses etc.

1. The grasses used for hay preparation should have higher number of leaves. Hay should be sufficiently dry. Amount of leaves should be such that two- third nutrients of hay remain in the leaves.
2. Hay should be of bright green colour so that it contains high carotene and vitamins. It may be of brown in colour due to high moisture content and very high temperature. This colour indicates the loss of nutrient value in hay.

3. Hay should be free from weeds.
4. Hay should be free from molds and dusts.
5. It should have scent suitable for feeding.

Procedure of preparing hay:

Time of cutting: Plants should be cut at proper maturity stage to prepare hay. The lower the plants age the higher the hay quality. On the other hand, the higher the plants age the lower the hay quality. But the suitable age of cutting is the flowering stage.

Proper drying: The plants should be properly dried during hay preparation to keep the plants free from molds and to store it avoiding excessive heat. The plants should be dried quickly avoiding excessive sunlight so that they can maintain the characteristics of quality hay. The cut plants should be inverted time to time in sunlight so that they cannot lose excessive moisture. Normally, the green plants contain 75- 80% moisture. The plants should be dried to 20- 25% moisture level for hay preparation. Care should be taken not to get wet by rainfall during drying in the sunlight.

Hay preservation: Hay must be preserved under dry condition.

Task:

1. The learners will submit reports on whether livestock raising is possible supplying only concentrate instead of roughage or not.
2. The learners will prepare silage and will submit the steps in written form.

Exercise

Short Answer Questions

1. What are steps involved in crop seed production?
2. What is mulching?
3. What is plankton? How many types of it and what are they?
4. What should be the criteria of poultry feed?
5. What do you mean by sanctuary of fish?

Descriptive Questions

1. Describe the steps involved in production of seed potato.
2. What are the types of pond based on the age of cultivated fish? Describe each type of pond.
3. Describe the ordinances of fish conservation act.
4. Describe the steps involved in making poultry houses.

Multiple Choice Questions

1. Which disease of potato causes a large damage?
 - a. Late blight of potato
 - b. Wilting disease
 - c. Stem rot disease
 - d. Viral disease
2. What should be the amount of soluble oxygen in pond water?
 - a. 2 mg/ liter
 - b. 3 mg/liter
 - c. 5 mg/liter
 - d. 7 mg/ liter
3. Late blight of potato infestation occurs-
 - i. At low temperature
 - ii. At dense fog
 - iii. During excessive rainfall

Which one is the correct?

- a. i & ii
- b. i & iii
- c. ii & iii
- d. i, ii & iii

Read the following paragraph and answer to the question number 4 & 5:

Farida Begum prepared a pond of 15 decimals at the southern part of her house for fish culture. She applied appropriate doses of fertilizer and lime. After releasing fish most of them had died.

4. How much lime in kg will have to apply to the pond of Farida Begum?
 - a. 20 kg
 - b. 25 kg
 - c. 30 kg
 - d. 35 kg

5. What is the reason behind death of fish?

- i. Difference in water temperature
- ii. Infestation of harmful parasites
- iii. Difference in oxygen

Which one of the followings is correct?

- a. i & ii
- b. i & iii
- c. ii & iii
- d. i, ii & iii

Creative Question

1. Kanak Barua prepared a pasture land to rear animal. Although in rainy season, there produce a large amount of grasses in his pasture land, he could not meet the demand of grass in dry season. For that reason, he took measures to preserve green grasses properly for supplying feed all the year round. Then Kanak Barua inspired most of his neighbors to preserve feed this way.
 - a. What is called feed?
 - b. Explain how does concentrate feed increase the production of animal?
 - c. Explain the technology adopted by Kanak Barua.
 - d. Evaluate the program of Kanak Barua.

Chapter Three

Agriculture and Climate

In this chapter, at first unfavorable environment, crops with their varieties tolerant to unfavorable weather and their importance have been discussed. Thereafter, the influence of climate change on the production of crops, fishes, and livestock and poultry have been discussed. At the last part of this chapter, the adaptation mechanisms of crops, fishes, and livestock and poultry to climate change have been discussed.



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

- describe the characteristics of the crop varieties tolerant to stress condition.
- explain the importance of crops tolerant to stress condition.
- describe the influence of climate change on agriculture (crops, fish, and livestock and poultry).
- evaluate the influence of climate change on agriculture.
- describe the adaptation mechanisms of crops, fishes, livestock and poultry to climate change.
- evaluate the necessity of adaptation of crops, fishes, livestock and poultry to climate change.

Section- 1

Crops and Crop Varieties Tolerant to Adverse Weather

We have learnt about unfavorable environment and stress weather in class VIII. In Bangladesh, there exists different unfavorable or stress weather in different time in the year due to climate change. Very cool or comparatively lower cool in winter; very high temperature, drought, salinity, flood or water shortage in summer, are the unfavorable or stress weather for crop production in Bangladesh. If we have no proper management practices earlier to face these conditions, they can cause severe yield loss. The pre-requisites for crop production under unfavorable or stress environment is to select suitable crops or crop varieties tolerant to different unfavorable or stress environment. In the mean time, scientists of Bangladesh have developed new varieties of many crops tolerant to unfavorable environment and they are still continuing their research regarding this aspect. Now we shall discuss on different crops or crop varieties tolerant to different unfavorable or stress environment.

Crops tolerant to cool weather

Duration from November to February is the season in Bangladesh. The lowest minimum temperature in winter exists in January or February. In winter, the average maximum temperature ranges from 24°C to 28°C and the average minimum temperature ranges from 7°C to 15°C. In our country, the higher intensity and duration of coolness increase the yield of winter crops like potato and wheat. But cool, i.e., low temperature during pollination and grain formation in transplant aman rice and boro rice causes higher unfilled grains thereby decreases yield. During this period, if temperature falls below 20°C and exists for several days, yield is reduced drastically. For this reason, it is necessary to sow seeds or transplant aman seedlings in proper time. The characteristics of two varieties of rice tolerant to cool weather are described below:

a) BRRI dhan 36: Bangladesh Rice Research Institute has developed this variety for the cool regions of the country. This variety was released by National Seed Board as BRRI dhan36 in 1998. This variety is an early variety for boro season having 90- 95 cm height, 140- 145 days life cycle and 5.0- 5.5 tons per hectare yield. This variety is suitable for those areas where temperature exists below 15°C during seed sowing.

b) BRRI dhan 55: This variety was released in 2011. The height of this early and high yielding variety is 100 cm and average yield is 7 tons per hectare in boro and 4.5 tons per hectare in aus season. Since this variety can tolerate moderate cool temperature in boro season, it can be cultivated in cool-prone areas. Besides, this variety can also be tolerate salinity and drought. The life cycle of this variety is 145 days in boro season and 100 days in aus season.

Crops tolerant to drought

We know that without rainfall for 20 days or more in dry season is called drought. Without rainfall or scarcity of rainfall causes soil water deficit. Therefore, it causes water deficit in plants. This condition is called drought condition. Yearly 30- 40 lac

hectare of lands face drought in different levels in rabi, kharif-I or kharif- II seasons in our country. Consequently it causes 15- 90% yield loss depending on the intensity of drought. We have learnt elaborately about the technologies of crop cultivation under drought- prone areas in class viii. Among those technologies, most effective one is to cultivate drought tolerant crops or crop varieties in drought- prone areas. Generally, the roots of drought tolerant crops are heavy, highly branched and deep. The leaves of these crops are small, narrow, thick or twisted. Date, jujube, arhar, water melon, some wheat varieties etc. are drought tolerant crops. Now we shall discuss about some important drought tolerant crop varieties.

Task: Learners will write down the characteristics of drought tolerant and cool tolerant crops and will present the list of drought tolerant and cool tolerant crop and crop varieties in the class.

Drought tolerant rice varieties:

BRRI dhan 56: This variety is released in 2011 for transplant aman rice season. Its plant height is 115 cm and life cycle is 105- 110 days. Yield is not reduced remarkably if there is no rainfall for 10- 21 days at the reproductive stage. This variety yields 3.5- 4.0 tons per hectare under drought condition and 4.5- 5.0 tons per hectare under without drought.

BRRI dhan 57: This variety is also released for transplant aman season. Plant height is 110- 115 cm and life cycle is 100- 105 days. Yield does not reduced remarkably if there is no rainfall for 8- 14 days at the reproductive stage. This variety yields 3.0- 3.5 tons per hectare under drought condition and 4.0- 4.5 tons per hectare under without drought. Since the life cycle of BRRI dhan 56 and BRRI dhan 57 is shorter. they can avoid drought simultaneous with tolerant.

Drought tolerant wheat varieties:

BARI wheat 20 (Gaurov): This variety of wheat is medium short, short durational and high yielding. Leaves of this variety are narrow, moderately straight and dark green. The life cycle of this variety is 102- 108 days and yield is 3.5 to 4.6 tons per hectare. This variety can tolerate both high temperature and drought at the later stages of its life cycle.

BARI wheat 24 (Prodip): This variety of wheat is medium short high yielding and drought tolerant. Leaves of this variety are comparatively broad, curved and light green. The life cycle of this variety is 102- 110 days and yield is 4.3 to 5.1 tons per hectare.

Drought tolerant sugarcane varieties:

Ishwardi 33: This variety is drought tolerant and contains higher amount of sugar. It is an early maturing variety and its average yield is 100 tons per hectare.



Figure : BARI wheat 20

Ishwardi 35: This variety is as like as Ishwardi 33 and its average yield is 94 tons per hectare. Among the other drought tolerant sugarcane varieties there are Ishwardi 37, Ishwardi 39, Ishwardi 40 etc.

Drought tolerant other crop varieties:

BARI chhola- 5 (Pabnai): It is a light green colored variety having 50 cm height; seeds are small, smooth and grey- brown in color. Its life cycle is 128- 130 days and yield is 2.4 tons per hectare. The seeds have to be sown within the last week of October to first week of November in the drought- prone Barind region. Among the other drought crop varieties, there are BARI barley- 6, BARI brinjal- 8, BARI hybrid tomato- 3& 4, vegetable mesta etc.

Salinity tolerant crops:

Water uptake by crop plants from saline soil becomes problematic. Crop plants cannot be grown if salinity becomes higher. Salinity is increasing day by day at the southern coastal regions due to climate change. For that reason, it is necessary to increase the area under cultivation salinity tolerant crops or crop varieties at the coastal regions. Some crops, tolerant to salinity and susceptible to salinity, are enlisted in the table given below:

Highlytolerant to salinity	Moderately tolerant to salinity	Susceptible to salinity
Coconut	Sweet potato	Bean
Betel nut	Pepper	Lemon
Pulm	Chili	Orange
Barley	Cowpea	Carrot
Date	Mungbean	Onion
Sugar beat	Grass pea	Strawberry
Turnip	Pea	Lenil
Cotton	Jower	Mango
Spinach	Maize	Pomegranate
	Tomato	
	Hogplum	
	Guava	

Rice is the principal crop in the coastal saline regions. There are some local and improved rice varieties which can tolerate different levels of salinity. Among the local varieties there are Jata, Rajashail, Kajalshail, Bajail, Kalamanik, Garcha, Gabura etc. In the mean time Bangladesh Rice Research Institute has developed many salinity tolerant rice varieties. The main characteristics of these varieties have been described below:

BRRI dhan 40 and BRRI dhan 41: These two varieties have released for aman season in 2003. These varieties can tolerate moderate level of salinity at their seedling and booting stage. Plant height is 115 cm, life cycle is 145- 148 days and per hectare yield is 4.0- 4.5 tons. The coastal regions, where Rajashail, Kajalshail etc. local varieties are being cultivated, these two varieties can give twice yield if these are cultivated in that regions. Since these two varieties are photosensitive, if necessary, 30- 35 day old seedlings can be transplanted in 25- 30 depth of water.

BRRI dhan 47: This variety has been released in 2006 to cultivate in the salinity-prone areas in boro season. This variety can tolerate high level of salinity at seedling stage, whereas at the older stages can tolerate low to medium levels of salinity. Plant height is 105 cm, life cycle 152 days and per hectare yield under saline condition is 6.0 tons.

BRRI dhan 53: This variety is released in 2010 to cultivate at coastal saline- prone areas, specially in shrimp culture areas and on medium low land in aman season. This early variety is of 106 cm in height, 125 days life cycle and 5.0 tons per hectare yield. This variety can tolerate moderate level of salinity at growing and vegetative stages.

BRRI dhan 54: This variety is also released to cultivate on saline- prone and medium low land areas in aman season. It is an early variety and its plant height is 115 cm, life cycle is 135 days and per hectare yield is 5.5 tons. This variety can also tolerate moderate level of salinity at the growing and reproductive stages.

BINA dhan 8: This salinity tolerant rice variety is developed by Bangladesh Institute of Nuclear Agriculture and released in 2010. The life cycle of this variety in boro season is 130- 135 days. Yield of this variety under saline condition is 4.5- 5.5 tons per hectare. This variety has also ability to tolerate various diseases and insects.

Task: The learners will present a list preparing on the crops and crop varieties in the class that are tolerant to salinity and suitable to cultivate in the coastal regions.

Other crop varieties tolerant to salinity:

BARI alu 22(Saikat): This salinity tolerant potato variety is developed by Bangladesh Agricultural Research Institute in 2004. The potato of this variety is long- round and red in color. Yield of this variety is 25- 30 tons per hectare.

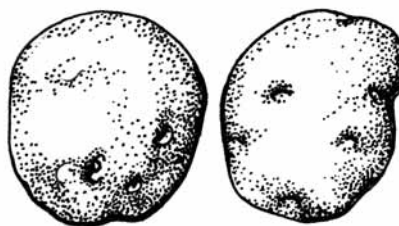


Figure : BARI alu 22

BARI misti alu 6 and 7: The skin color of these two sweet potato varieties is deep orange and their inside color is light orange. The sweet potato contains medium level of carotene and high level of dry matter. Crop duration is 120- 135 days. These two varieties can give 40- 45 tons per hectare yield under normal condition and 18- 20 tons per hectare under saline condition.

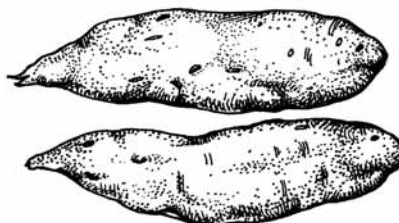


Figure : BARI misti alu 6

BARI sarisha- 10: The plant of this variety of mustard is dwarf, height is 80- 100 cm, life cycle is 85- 90 days and yield is 1.2- 1.4 tons per hectare. This variety can also tolerate drought as well as salinity.

Salinity tolerant sugarcane varieties:

Ishwardi 39: This high yielding variety contains high level of sugar. Its yield is 80- 90 tons per hectare depending on the region. This variety can tolerate flood and drought as well as salinity. This variety is suitable for producing molasses.

Ishwardi 40: This variety also contains high level of sugar as like as Ishwardi 39. This high yielding variety is of fast growing and early maturing. Its yield is 85- 95 tons per hectare depending on the regions. This variety can also tolerate flood and drought as well as salinity.



Figure : Ishwardi 40

Crops tolerant to flood or submergence

In each year, more or less flood visits Bangladesh. Flood is one of the most important natural calamities in Bangladesh. The mid regions of Bangladesh become flooded due to river-estuarine flood and flood caused by excessive rainfall; the north- eastern regions due to flash flood and coastal regions due to tidal surge. Among the cultivated land in our country, there are 12.30 lac hectares of lands that are severely flood- prone and 50.50 lac hectares are moderately flood- prone. Twenty six lac hectares lands were inundated by the dangerous flood occurred in 1988. Apart from temporary water stagnancy caused by flood, some regions of Bangladesh like Bhabadaha area of Khulna and Jessore have faced water stagnancy permanently. Most of the plants, other than aquatic plants, cannot tolerate water stagnancy caused by flood or other reasons.

The main crop of the large flood- prone area in the country is rice. Rajashail and Fulkuri are the rice varieties among the local flood tolerant deep water aman rice varieties. The plant height of these varieties of rice increases simultaneous with the increase in the height of flood water. Even plant height can be increased up to 25 cm and can also survive in 4 m depth of water. BRRI dhan 44 is one among the tall varieties of aman rice. This variety of rice can tolerate 50 cm height of flood water in the tidal regions. The loss caused by flood can be minimized by cultivating late aman rice varieties in flood- prone areas after removal of flood water. BR 22 (Kiron) and BR 23 (Dishari) are the two among the late rice varieties. The rice grain of Kiron and Naizershail is more or less similar but yield of Kiron is twice than that of Naizershail. The Kiron and Dishari, these two varieties of rice, can be cultivated up to 15 Ashwin in flood- prone areas after removal of flood water. Thus, crops become safe from high level of tidal flood. The variety Dishari can also some extent tolerate salinity. For this reason, this variety is very popular in Khulna and Bgerhat regions for transplant aman season. The flash flood- prone regions of the north- eastern part of the country possibly face flood at the ripening stage or rice in boro season. For that reason, early maturing high yielding boro rice varieties like BRRI dhan 28, BRRI dhan 45 should be cultivated in these regions. The recently developed two varieties of rice of aman season for cultivating in these regions are-

BRRI dhan 51: This variety is released in 2010 to cultivate under flash flood- prone areas in aman season. Plant height of this variety is 90 cm and ripened grain color is whitish. If one week after transplanting, the seedlings of this variety become submerged for 10- 15 days, seedlings do not die. For that reason, yield is not reduced. The life cycle of this variety is 140- 145 days and yield is 4.5- 5.0 tons per hectare under flood free condition; whereas, life cycle is 155- 160 days and yield is 4.0- 5.0 tons per hectare under flooded condition.

BRRI dhan 52: This variety is also released in 2010 for aman season to cultivate under flash flood- prone regions. The plant height of this variety is 116 cm. The seedlings can remain in submergence for 12- 14 days after one week of transplanting. The life cycle of is 140 days and yield is 4.5- 5.0 tons per hectare under flood free condition; whereas, the life cycle is 155 – 160 days and yield is 4.0- 4.5 tons per hectare under flooded condition.

Other crop varieties tolerant to submergence or flood:

Sugarcane varieties:

Ishwardi 32: The yield of this variety, tolerant to submergence or flood, is 104 tons per hectare.

Ishwardi 38: This variety of sugarcane contains high amount of sugar. This variety is fast growing and early maturing type. The yield of this variety is 113 tons per hectare and it is highly tolerant to flood. Besides, the varieties named Ishwardi 34, 36, 37, 39, 40 can tolerate high level of flood and submergence.

Kenaf variety:

The kenaf variety BJRI kenaf- 3 (Bat kenaf), developed by Bangladesh Jute Research Institute, can tolerate submergence. Kenaf is a fiber crop like jute. The leaf of this kenaf variety is un- segmented like banyan leaf and yield of this variety is 3.5 tons per hectare.

Task: The learners will prepare a list of crops and crop varieties tolerant to flood and submergence and will present in the class.

New words: Cool tolerant crops, crops tolerant to flood or submergence

Section 2

Climate Change and its Effect on Agriculture

Influence of climate on crop production in Bangladesh

From the beginning of the creation of the earth, the climate is being changed gradually; thereby getting suitable for animals and plants to survive. The trend of this climate change was very slow. But a remarkable change in climate is being noticed in many countries of the world for the last century. Climate change due to increase in

temperature has been created an unfavorable condition in nature. The developed world is responsible for this change. The concentration of green house gases in the atmosphere is increasing due to urbanization, mechanical civilization, industrialization, injudicious use of fuel and coal, deforestation etc. For that reason, world temperature is increasing day by day. Now- a- days, Bangladesh is identified as the most affected and hazardous country in the world. Human Development of the United Nations (2007- 08) said that seven core people of Bangladesh will be affected due to climate change. Due to geographical location and geo- natural characteristics, Bangladesh is one of the hazardous countries from the past. It was said in the report of IPCC (Inter Governmental Panel on Climate Change) that due to climate change-

1. The average annual temperature during 1985- 1998 has increased 10C in the month of May and 0.50C in the month of November.
2. Salinity has been found in the 8 lac 30 thousand hectares of land in Bangladesh.
3. Average rainfall has increased in Bangladesh. There were floods in 2002, 2003, 2004 and 2007, i.e., has increased the number of severe flood.
4. The number of cyclones in the Bay of Bengal has increased.
5. The saline sea water has entered up to 100 km inside the country through the rivers in summer.

Considering the environment and production factors of the country, the most affected and hazardous sector due to climate change is agriculture. The various unfavorable conditions may be created in the country due to climate change; such as-

1. Very high temperature in summer.
2. Irregular and untimely rainfall.
3. High rainfall within short time, consequently water stagnancy and land slide.
4. Low rainfall in dry season.
5. Increase in severity and number of flood.
6. Crop damage due to sudden flood and drought.
7. Excessive cool and hot.
8. Increase of lands under salinity and soil erosion in the coastal regions.
9. Increase of the intensity and number of cyclones and tidal surge.
10. Fog, hailstorm etc.

Task: The learners will prepare a list of unfavorable conditions created due to climate change in Bangladesh.

Effect of temperature on crop production

We have previously learnt that the summer and winter temperature is increasing in Bangladesh due to climate change. Simultaneously, the abnormalities of fluctuating temperature in summer and winter are also observing. Sometimes, very high temperature is being observed in summer and very low temperature in winter. In Bangladesh, yield of HYV rice will be decreased and disease infestation in wheat will be increased due to increase in temperature. If temperature is increased by 20C from the existing temperature, wheat cultivation will not be possible. Potato and other winter crop production will be severely affected. The intolerable high temperature for rice is 350C. Flowering stage is the most sensitive for rice. At this stage, if the temperature remain at 350C or more, unfilled rice grains will be increased. There is a possibility of increasing yield of boro rice with the increase of temperature and CO2 concentration but will not be possible due to lack of water. Low temperature hampers normal growth of rice plant, turns rice plants yellowish, make rice seedlings weaker and longer the life cycle of rice crop. Yield of early planted boro rice and late planted aman rice are reduced if temperature is lowered at flowering and pollination. Consequently excessive unfilled grains are found in rice. To adapt this condition, it is necessary to transplant seedlings in proper time, to develop crops or crop varieties tolerant to temperature and to increase area under cultivation of these crops.

Effect of drought on crop production

Drought is one of the natural calamities influencing crop production. It is becoming serious day by day due to climate change. Lack of average rainfall at crop growth stages creates dehydrated condition in soil. The influence of drought in agriculture is the consequence of the lower rainfall and excessive evaporation of soil water. Yearly 30- 40 lac hectares of land in the country is affected by different levels of drought. There was the longest drought in Bangladesh in 1999 with 50 years. In that time, there was continuous drought for 4 months. There was the lowest rainfall in 2010 after 1995. Overall crop growth is reduced due to drought. Crop yield in drought-prone areas depends on intensity, duration of drought and crop growth stages. The drought can be divided into three categories depending on the injury caused by drought; such as-

1. Severe drought (yield loss is 70- 90%)
2. Moderate drought (yield loss is 40- 70%)
3. Normal drought (yield loss is 15- 40%)

Task: Learners will prepare a report on the influence of drought caused by climate change on crop production and will present in the class

Depending on the growing season of the crops, the drought can be again divided in to three categories; such as- rabi drought, Kharif- I drought and Kharif- II drought.

Due to climate change, the intensity of drought is being increased in the south- western regions of the country. Rajshahi, Chapainawabganj, Dinajpur, Bogra, Kushtia, Jessore, Dhaka and some parts of Tangail are the severe drought- prone areas. Rangpur and Barisal districts and some parts of Dinajpur, Kushtia and Jessore districts are moderately drought- prone areas. The alluvial areas of the Tista, the Brahmaputra and the Meghna are normal drought- prone areas. But at present, due to the decrease of water flow in the Tista river, the intensity of drought in the Tista regions has increased in dry season.

The aman rice is cultivated in the 60% of the arable land in the country. The aman rice is cultivated depending on rain. In this season, the farmers do not have previous preparation to irrigate. But at present, due to lack of adequate rainfall, the aman rice is facing drought in this season. Specially due to drought at flowering and grain filling in rice, the yield of high yielding transplant aman rice is reduced by 43- 50%. The farmers are being looser for getting low yield. Besides, drought hampers the cultivation of aus rice, boro rice, jute, pulse and oil crops, potato, winter vegetables and sugarcane. The drought occurs in the month of March- April, hampers land preparation. Consequently, the cultivation of broadcast aman, aus and jute is not possible in scheduled time. The drought occurs in the month of May-June, hampers the broadcast aman, aus and jute crops standing on the field. The insufficient rainfall in the month of August hampers the cultivation of transplant aman rice. The lower rainfall in the month of September-October lessens the yield of broadcast and transplant aman and delay the cultivation of pulse and potato. In dry season, depth of river is decrease, water layer goes down. Sometimes, there is a lack of irrigation and drinking water.

As the adaptive techniques of drought, we can change cultivation method; can cultivate crops that require lower amount of water, can cultivate crops that encourage mulching etc. The area under cultivation of drought tolerant local varieties, are to be increased after their necessary improvement. If transplanting of rice is delayed due to drought, late and drought tolerant varieties have to be cultivated. The cultivation of drought tolerant crops like chickpea, sesame as oil crops etc. have to be popularized.

Effect of salinity on crop production

Influence of salinity is found in coastal soil of Bangladesh. Due to cyclone, seashore, and severe tidal food , saline water directly enters the land, thereby salt content is increased in soil. Again, in dry season, underground salt lifted upward through evaporation of soil water. Consequently it hampers soil fertility. The 8.33 lac hectares of land was affected by different levels of salinity in 1973. In 2000, it was 10.20 lac hectares. At present this amount is 10.56 lac hectares. At present, 62.52% of the coastal 16.89 hectares of land is affected by different levels of salinity. Based on the levels of salinity, the salinity affected areas are divided into five categories, such as-

- 1) Very low salinity affected soil
- 2) Low affected salinity
- 3) Moderate salinity affected soil.
- 4) Severe salinity affected soil
- 5) Very severe salinity affected soil.

Task: The learners will show the tendency of increasing salinity in Bangladesh due to climate change in map.

Within 27 years, from 1973 to 2000, salinity has been increased by 22.45% in the coastal regions and from 2000 to 2009 within last 9 years, salinity has been increased by 3.5%. Some new areas of Satkhira, Patuakhali, Barguna, Barisal, Jhalokathi, Pirojpur, Jessore, Narail, Gopalganj, Madaripur have been affected by salinity. Consequently, the agricultural production has been decreased remarkably. The trend of increase in salinity will be increased

more as the consequences of increase of temperature and decrease of rainfall due to climate change. Due to the increase of world temperature, the sea level is increased and thereby salinity will be dispersed in the new areas. Naturally, the 50% lands of coastal area cannot be used because they are flooded at different levels. Again the cultivation of crops in the coastal regions will be fallen under havoc as a result of increase of salinity.

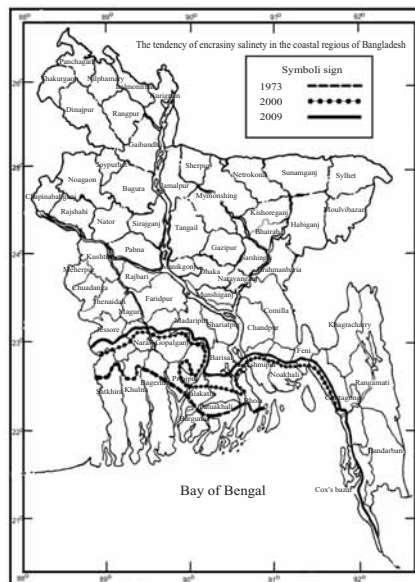
In that situation, cultivation of salinity tolerant crops and crop varieties in the coastal regions has to be popularized. The salinity tolerant local varieties have to be improved. The different agronomic management practices have to be adopted to cultivate crops in the saline areas. In aman season, the varieties of BR 23, BRRI dhan 40, BRRI dhan 41 and in boro season, the varieties of BRRI dhan 47, BINA dhan 8 have to be cultivated.

Effect of submergence or flood on crop production

Yearly 25% of lands of our country are flooded in different levels. The flood visits this country in the month of May to September every year. In this time, more than 60% cereal crops are produced in the country. Due to frequent flood, the farmers become obliged to cultivate local varieties of aman rice since these varieties can grow in deep water.

The intensity, duration and frequency have been increased due to climate change. The melted water of ice in the Himalayan, excessive rainfall as well as siltation in rivers are increasing the intensity of flood. We have learnt about four types of flood in Bangladesh in class vi. Flood caused by river water and rainfall do not create so problems in the coastal regions. But its influence is higher in the flood-prone area of the middle regions of the country. Besides, it causes a large damage to life and assets.

The flood caused by cyclone and tidal surge cause a large damage in the coastal regions. Submergence by saline water is created in the land. Consequently, due to submergence and salinity, it creates the environment unfavorable to crop production. The districts of Cox's Bazar, Chittagong, Sunamgonj, Sylhet, Netrokona, Nilfamari etc. face flood due to heavy rainfall. Almost each year, ripened boro rice of thousands of hectares of land of this area are damaged by flood due to excessive rainfall before harvest. About 4 thousand square kilometer area of north-eastern regions and one thousand four hundred square kilometer area of the south-eastern regions of the country are such type of excessive rainfall-prone areas. In 2002, numerous house-



holds and crops of about 31500 hectares of land in Chittagong and 12 upazillas of Cox's Bazar were damaged by flood due to excessive rainfall.

It is found from the research that, due to climate change, the flood-prone areas in Bangladesh will be increased by 6%. Consequently, the crop in the Ganges basin will be damaged in 11%, in the Meghna basin 7% and in The Brahmaputra basin 2% and 6400 km length of flood control bund will be gone under risk.

It will be necessary to construct more bunds and sluice gates to control flood water and to protect from the entrance saline water. During construction of these, it will be necessary to think about environmental aspects. If there is any faulty decision, we will have to suffer for a longer duration. A sluice gate was constructed in 1963 to protect the entrance of saline sea water through the rivers of Bhabadaha area of the districts of Khulna and Jessore. The sluice gate was used to keep closed in summer so that saline sea water would not enter into the river. Consequently, tidal saline and turbid water was obstacle and silt was started to deposit. Thereby, once the river lost its deepness by siltation and the movement of water towards the sea through the sluice gate becomes blocked. Consequently, the permanent submergence occurred in about 8 lac hectares of land Bhabadaha area in 1983. It became severe in 2003 and 2004. Besides, crop fields, house-holds, roads and streets submerged under water. Some days ago the farmers who had gola full of rice and cattle-shed full of cattle; now they have just nets in their hands.

As an adaptation technique, the early maturing crop varieties have to be cultivated in the flood prone areas due to excessive rainfall compared to the traditional varieties. BRRI dhan 28 and BRRI dhan 45 become matured early compared to BRRI dhan 29. The late varieties of rice like naizershail, BR 22, BR 23 and BRRI dhan 46 have to be cultivated in the middle regions of the country after flood. If there is no land for seed bed preparation due to flood, dapog seed bed has to be prepared. The supply of agricultural inputs to the farmers has to be ensured to cultivate vegetables and other crops after flood without any delay.

Task: The learners will discuss the influence of flood and submergence caused by climatic change and will present in the class in written form.

New words: Severe drought, normal drought, rabi drought, kharif- I drought, kharif- II drought

Section 3

Adaptation Mechanisms in Response to Climate Change

Adaptation mechanisms of crops

We know that to survive in unfavorable environment, plant adjust themselves by different physiological and bio-chemical changes. The technique of this adjustment is known as adaptation. Based on the knowledge about adaptation mechanisms of crops, the agricultural scientists have been developed various crop varieties which are suitable to be cultivated under unfavorable condition. We shall discuss the adaptation mechanisms of crops to drought, salinity, submergence or flood etc. unfavorable or adverse environment in this chapter.

Adaptation mechanisms of crops to drought

We have learnt about drought in previous. There is a lack of moisture in soil, low water vapor in air, high temperature and high intensity of sunlight under drought condition. In this condition crop plants survive through drought escaping and drought prevention.

1. Drought escaping:

The easiest way of adaptation of crops in drought is drought escaping. The completion of life cycle during the period from starting of rainfall to starting of drought to getaway themselves from drought is called drought escaping. There are some short durational plants in desert regions. Seeds of these plants germinate just after rainfall and complete their life cycle within 2 months.

There are some types of crops of which life cycle is short. There are some varieties of millets which mature within 60 days of germination. The early varieties of some crops can escape from one or two drought as they become matured within short duration. If the duration needs for flowering, fruit setting and maturity is short, they can escape from drought, such as cowpea requires 17- 20 days for flowering to maturity. Therefore, by cultivation cowpea in drought- prone areas, the crop can be harvested before appearing drought.

2. Drought prevention:

The mechanism of surviving crop plants under drought condition is called drought prevention. The drought prevention of crop is again divided into two categories, such as- a) drought tolerance b) drought avoidance. Now we shall discuss the mechanisms of drought tolerance.

a) Mechanisms of drought tolerance:

The survival ability of crop plants with low water balance in the plant body under condition of drought is called drought tolerance. These crops show normal growth and bear flowers and fruits after disappearing of drought condition. The mechanisms of drought tolerance of crops are discussed below:

- 1. Résistance to cell dehydration:** This type crop store adequate amount of solutes in the cell under drought condition. Consequently high osmotic pressure exists in the cell. Water does not dry out from the cell and the cell does not become flaccid. This condition is found in cotton during drought.
- 2. Thick cell membrane:** In some crops, leaf has thick cell membrane; consequently the leaf does not wilted, if the cell water is less in leaf.
- 3. Starvation:** Some plants lesser their rate of photosynthesis under drought condition. In this condition although the leaf cells become wilted, the guard cells deposited various solutes in the cells and maintain turgor pressure, make entrance of lower amount of carbon dioxide to continue limited photosynthesis. Thus under drought, plants just survive under drought condition.

4. **Protein and proline accumulation:** Due to the effect of drought, the protein is broken down and takes part in different bio- chemical activities. The higher storage of protein in plant body helps in drought tolerance. Again, by breaking down protein, various types of toxic substances are produced. For that reason, some plants produce a chemical substance named proline which lessens the toxicity level and makes the crop plants drought tolerant.
5. **Absence of vacuole:** The differences in drought tolerance in crop plants are found due to variations in morphology. The plant parts in which there is no vacuole, they can tolerate drought, such as- due to drought although leaves of some plants die, leaf bud does not die. The leaf buds tolerate drought and started to grow after disappearing of drought.
6. **Dormancy:** Above ground parts of many plants die under drought condition but the under-ground parts remain viable in dormant state as tuber/ bulb/ rhizome etc. These germinate under favorable condition.

b) Mechanisms of drought avoidance:

We learnt previously that there are two mechanisms of drought prevention in crop, such as- drought tolerance and drought avoidance. The main drought avoidance mechanisms of crop plants are described below:

1. **Control of stomata:** Some plants face the drought by lowering loss of water caused by transpiration by controlling the opening and closing of stomata. For example, barley and other tall varieties of wheat crop open stomata in the morning for few times and rest of the time remain closed. Again, many crop plants lower their size of stomata, close stomata, if there is lack of water in cells and increased environmental temperature. Most of the varieties of bean avoid drought this way. Again, leaves of many crop plants contain stomata in lower amount, stomata remains in the leaf whole (sunken stomata). Therefore, transpiration becomes lower and thus water is conserved.
2. **Control of transpiration:** Many plants deposit lipids on the upper surface of the leaves and lower the transpiration rate when they remain under drought condition; such as- soybean crop. Again many plants make a layer on the upper leaf surface by wax or densely hair to lower transpiration.
3. **Decreasing leaf size:** Many plants lower transpiration under drought condition by decreasing leaf size; such as cowpea. Many plants decrease leaf size by burning leaf edge or leaf tip.
4. **Leaf shedding:** Many plants lower transpiration by shedding lower older leaves under severe drought condition.
5. **Increasing photosynthetic efficiency:** Although some plants lower transpiration by controlling stomata, they photosynthesize more by intaking little amount of carbon dioxide through stomata. It is found in maize, sugarcane etc. crops.

6. **Efficient root system:** Some plants face drought condition by uptaking more water by increasing root length, root number and root density; such as- this tendency is found in many varieties of maize, cotton and wheat. If the higher depth and density of root are present in an single crop, this crop becomes more tolerant to drought; such as- Jower and Bajra. Again, groundnut, Pigeon pea are deep rooted and are drought tolerant.
7. **Leaf rolling and leaf curling:** Many cereal crops; such as- jower, millets, also curl their leaf under drought condition except decreasing leaf size. Again, some crop plants decrease the sunlight absorbing area of leaf by curling their leaves. Consequently, due to the decrease of transpiration loss of water they adapt drought condition.
8. **Changes in leaf orientation:** Many plants change their leaf orientation towards the sunlight or at straight under drought condition. Consequently, water is saved by decreasing transpiration. Many dicotyledonous crops including groundnut, cotton and cowpea avoid drought by this process.

Task: The learners will write down the mechanisms of drought adaptation in their note book and will present in the class.

Adaptation mechanisms of crops to salinity

We learnt about saline condition, crop production techniques under saline condition in class viii. The crops are divided into two categories based on the response to salinity; such as a) Halophytes- gol pata, keora and b) Glycophytes- sugarbeat, bean, cotton. The halophytes plants can germinate in saline condition and can complete their life cycle there but glycophytes can do this.

The concentration of soil water of saline soil is high as higher amount of calcium and sulfate salts of sodium, calcium, magnesium etc. are present in water in soluble form. To survive crop plants in this condition, the cell sap concentration of plants has to be higher compared to the concentration of soil water. If not higher, the plants cannot absorb water and nutrient from soil; on the other hand plants become wilted due to loss of water. In this condition, to maintain turgidity of plant cell, it is necessary to collect various ions (K^+ , Na^+) from soil to overcome this obstacle made by salinity. Thus the excessiveness of ion occurs in plant body. But salinity tolerant plants control the uptake of ions. Leaves some plant species have salt net through which they can drain out excess ion. Again some species enlarge their leaf size and thereby lower the salt concentration in their body. In some species there is special arrangement in leaf to store excess ion.

There are some species that do not uptake ion under salinity condition but they take other technique. These plants store organic substances in vacuole to maintain turgidity of root cell. The volume of vacuole of these types of plants is 95% of their total cell volume. Among the organic substances stored in the vacuole, the photosynthetic product is higher.

Adaptation mechanisms of crops to submergence or flood

Besides aquatic plants, most of the plants cannot survive under flood or submergence or under saturated condition of soil water. In this condition, the plant roots cannot respire due to the lack of oxygen in soil. The quicker the soil or soluble oxygen in soil water become empty, the quicker the plants die. Rice is a water loving plant. Rice plant has aerenchyma tissue. This tissue has a lot of air spaces. Oxygen is stored in these air spaces. Consequently, if rice plants do not go under water fully, they can survive under flood or submergence and give good yield. But if submerged for long time, they die. The plant height of deep water rice increases with the increase of flood water. The internodes of the plants of such rice varieties possess a kind of meristematic tissue which is divided quickly with the increase of the height of flood water and thereby increase plant height and face flood. Again the tall varieties of rice can escape from flood due to their height.

Adaptation mechanisms of crops to high temperature

The rate of photosynthesis and respiration is decreased at high temperature. The rate of decrease in photosynthesis is more compared to that of respiration. In this condition, the protein of crop plants become degraded and water loss occurs. At high temperature, special non-degradable protein is formed in the plants that are tolerant to high temperature. The high temperature tolerant plants can remove the broken protein from the body.

Task: The learners will write down the mechanisms of salinity, submergence and high temperature adaptation in their note book and will present in the class.

New words: Drought escape, drought prevention, drought tolerance, proline, halophytes, aerenchyma tissue

Section- 4**Effect of Climate Change on Fisheries Sector**

Fisheries sector plays an important role to meet up the nutritional requirement, create employment opportunity, earn foreign currency that means overall economic development of Bangladesh. Bangladesh possesses third position in the world for collecting fish from internal water bodies and possesses fifth position for culturing fish. There is about 4.7 million hectare area of internal open and closed water body including river, canal-beel, haor, pond, lake, tidal area etc in this country. Moreover, there is wide sea area of 1 lakh 66 thousand square kilometer. Presently, fish production from these water bodies is not sufficient as compared with its area. More production can be possible from them. Presently (2010-2011), fish production in this country is about 30.60 metric ton and target production is 34.78 metric ton up to the year of 2012-2013. Although, fish production in this country has gradually been increased for last few years, and it is increased due to fish culture. But, natural fish production in internal open water bodies like river, canal, beel, haor, tidal land has been decreased drastically. Biodiversity of fishes is also decreased there and this happened due to climate change. Climate change causes increase of environmental temperature, increase of the surface height of the sea, increase of salinity, absence or shortage of rainfall. Severity and number of cyclone and tidal wave is increased. For this reason, fish culture, natural breeding of fish and their movement is hampered. The effect of climate change on fisheries sector is described below:

a) Effect on fish culture and fry production

- 1) In our country, farmers release fries in the seasonal pond if it is merged by rain water in April-May. Climate change decreases rainfall or causes late rainfall. That's why fries releasing becomes late. Besides, pond is also dried out quickly after the fries are released lately. As a result, culturing period is reducing and small fishes are to be marketed before reaching their maturity. In this way, farmers are losing.
- 2) Fish breeding and fry production in hatchery are inhibited due to the increase of temperature and low rainfall which are caused by climate change. In hatchery, fish does not give response for artificial breeding due to not getting favourable environment for breeding and high temperature. They do not release eggs even they bear in their belly. Eggs are being absorbed in the body. If fish release eggs, these are not fertilized or very less amount is fertilized. Thus, climate change is hampering the fry production in the hatchery.
- 3) Fishes are easily affected with the diseases due to high temperature in shallow pond and the rate of mortality is increasing. As a result, production is becoming less and farmers' income is decreasing.
- 4) Water is getting less in culture pond due to low rainfall. As a result, farmers are spending much money for supplying water in the pond or farm.
- 5) Severity and number of flood, cyclone, tidal wave is increasing due to climate change. That's why, difficulty of farmers is increasing with the increase of amount of loss in fisheries sector. Fishes are going out of the pond.
- 6) Culture ponds in coastal area may be merged due to the increase of the height of the level of sea surface.

b) Effect on fish production in internal open water body

- 1) Less water is found in river due to low rainfall and as a result, it is easily possible to harvest fish in low water. Thus, small-big and matured fishes are being caught. As a result, biodiversity and permanent production of fish are hampering.
- 2) Sea surface height is increasing due to the increase of temperature and that's why, salinity is entering towards the main land. In this way, natural breeding and living ground of fresh water for fish are decreasing in coastal area. At the same time, production is also decreasing.
- 3) In beel, baor, tidal area of our country, month of April-May is the breeding period of native type small fish. In the recent years, water body is not to be merged by water till the month of July due to absence or low rainfall during rainy season. That's why, fish breeding is being hampered greatly. As a result, this affects whole fish production and nutrition and livelihood of those people who are involved with harvesting fish.
- 4) In our country, naturally rui types of fish release eggs only in Halda river. They release eggs during heavy rainfall after extreme heat in the month of Boishakh. Then fishermen collect fertilized egg from the river and produce fries by hatching the eggs.

Due to increase of temperature caused by climate change, egg maturity of brood fish comes earlier. On the other hand, starting time of rainfall is gradually going backward. Thus, dissimilarity is observed between the physiological condition of fish and the time of rainfall. As a result, possibility of getting eggs is decreasing.

C) Effect on marine fish

1. Carbondioxide is increasing day by day in the air and that's why temperature of air and sea level are increasing. So, movement of wind and nature of rainfall are changing. Hence, fish movement in the ocean and their production are affected. Thus, fish quantity may be increased in one part of ocean. Besides, the place which is popular for safe living for fish may be fishless.
2. Global warming and climatic change cause the movement of fishes from tropical area to temperate area. Many fishes have already changed their migration route, breeding place and living space. As a result, the places of ocean where fishermen have been fishing based on their knowledge and experience since long past, if changes occurs to these places, they will fall in trouble.
3. Coral reef is the suitable living place for marine fishes where various types of fish live in and is used as breeding place. Coral is being destroyed due to increasing temperature in water, variation of waves, increasing acidity in ocean, pollution, changes of waves speed etc.

Task: Learners will write a report about the effects of climate on fisheries sector.

Section-5

Adaptation Mechanism in Fisheries Sector for the Perspective of Climate Change

It is important to overcome from the negative impact of climate change on fish biodiversity and production. Otherwise, in one way as environmental balance will be destroyed, in another way our food security will be seriously threatened. We need to take steps for adapting with the changing environment to overcome the negative impact of climatic change. For this purpose, following adaptation techniques can be undertaken-

1. Though salinity is increasing in coastal region due to climatic change, so steps should be taken to produce saline tolerant fish and fries. Like vetki, bata, porshe etc.
2. The water body where salinity is increasing, shrimp and crab can be cultivated.
3. Drought prone area where low rainfall occurs, big fries can be cultivated in the temporary water. For this reason, big fries should be stocked in the locality.

Tilapia is much more drought tolerant fish. Koi and deshi magur can also be cultivated in drought prone regions.

4. In flood prone areas or where more rainfall occurs, the banks of the pond should be raised or surrounded by net so that flood water can not enter into pond or pond fishes can not go away.
5. By raising bank of the ponds in flood prone areas, society based fish fry bank can be established. Fries can be stocked in that pond when flood occurred in that area.
6. In flood prone areas, fish can be cultivated in cage during flood.
7. If coastal area is immersed by water after breaking the groyne, stagnant water can be utilized by fish culture with proper planning, fish culture in cage and culture of crab in the affected areas.
8. Due to increasing temperature of the environment day by day, temperature tolerant fish cultivation and production of their fries can be carried out. For example: Magur, Rui, Shing.
9. If pond water becomes warm due to increasing temperature, topa hyacinth can be kept on bamboo frame making in few specific locations. Thus, fish can take shelter under topa hyacinth to protect itself from warm. For maintaining same purpose, some creeper plants can be given opportunity for generating on water nearer to bank of the pond.
10. Roaming area for sea fish is changing due to climatic changes.

Section-6

Effect of Climate Change on Livestock and Poultry

Global temperature and destruction of environment caused by human being is one of the reasons for climate change. Our country is regularly affected by different natural disasters. The disasters are attacking on different countries regularly due to climatic change. Livestock and poultry are greatly affected by various natural disasters like heavy tsunami, sea cyclone, tornado, flood and drought. For this reason, farm owner or farmers do not get economic benefit. For recovering this loss in some extent, several steps should be taken during and after the disaster. Considering the fact of natural disaster in Bangladesh, protection and awareness should be raised up against sea cyclone, tornado, flood, drought, mountain rain, excessive rainfall etc. By this time, sal forest of Barendra region, Patnitola and Najipur forest of Rajshahi have been

extinct. As a result, extreme drought occurs in this region. Except reestablishment of those forest areas, law of environment should be activated immediately for planning for coastal forestation, extension of forestation of uncategorized forest area in Chittagong hill tracts, rescue and re-dredging of country rivers and canals and protection of all kinds of hills. Along with social forestation in our country, trees should be planted in a wide range. These are long term permanent system. If steps are taken for implementation of these matters, our country, therefore, livestock can be protected from natural disaster caused by climate change. Various ways of problem evaluation of livestock caused by climate change are described below:

Drought related problem: Problems which are observed during drought

1. Scarcity of green grass.
2. Water is polluted.
3. Cattles suffer from malnutrition.
4. Cattles are affected by different diseases.
5. Dryness of field grasses.
6. External parasitic infection increases on the animal body surface.
7. Excessive heat creates intolerable situation for birds.
8. Reducing the health condition including chances of death.
9. Heat stress causes death of broiler and layer.

Flood related problem: The problems which are observed during flooding.

1. Water logging is created.
2. Maximum areas of country go under water.
3. Disease outbreaks.
4. Cattle feed is not available.
5. Water is polluted.
6. Problem in maintaining livestock is created.
7. Cattles suffer from malnutrition.
8. Infestation of different infectious disease and attack of worms are increased.
9. Toxicity generates in grasses, cattle become sick.
10. Environment becomes unhygienic, many animals die.

Problem related to tidal wave: The problems which are observed during tidal wave-

1. Water is polluted in tidal wave affected area.
2. Many livestock and animals die immediately after tidal wave and storm.
3. Dead birds pollute environment in want of burial.
4. Scarcity of animal feed occurs.
5. Animal death occurs due to affection of diarrhoea, stomach illness, bloating etc.

Section-7

Adaptation Mechanism in Livestock for the Perspective of Climate Change

Adaptation involves the technique to adapt of a species with its environment. It should be remembered that adaptation process is accomplished in animal body. Animal adaptation is controlled by environmental weather and climate. So, adaptation depends on environmental temperature, humidity, wind blowing and its properties, height of the place from the sea level and physical structure & physical condition of animal. Animal can survive by facing those properties of adaptation. It is the normal phenomenon of nature.

Although human being can protect them by their knowledge if suddenly massive climatic change occurs, but livestock and poultry can not be adapted in that situation. Because livestock and poultry are helpless and gentle animal. Many of them are to be able to adapt with the environment if the climatic change is occurred slowly in that area. Many species may also be extinct due to unable to adapt with environment. Peoples' help is required for animal adaptation in unfavourable and adverse environment. More emphasis should be given for solving the problems of drought, flood and tsunami.

Techniques for protection of livestock in drought:

1. Cultivation of different tree leaves including jackfruit, ipil-ipil, babla should be increased and their tree leaves should be fed to animals.
2. Boiled rice liquid, kitchen waste, rice polish, wheat bran, pulse bran, oil cake, molasses should be given to the cattle in sufficient amount during drought.
3. Vaccines of contagious disease should be given to livestock in regular basis.
4. Supplemented feed of green grass (like- green algae) should be fed to cattle.
5. Silage and hay should be prepared by grass before coming of drought season so that these can be provided livestock during drought season.

6. Instead of providing only dry straw, urea treated straw and urea molasses block can be provided to cattle.
7. Sufficient concentrated feed should be provided to cattle.
8. Clean sufficient water should be provided.
9. Washing of animals should be maintained.
10. Animal's body should be kept neat and clean and treatment should be done for parasites.
11. Animal should be kept in shady place free from heavy sunlight.
12. Treatment for sick animal should be carried out according to doctor's suggestion.



Fig: Cattle intake ipil ipil tree leaves during drought.

Techniques for protection of livestock in flood related problems:

1. Animal should be kept as high and dry place as possible.
2. Clean water should be provided to livestock and polluted water of flood can not be provided to them.
3. Dead body of livestock should be buried.



4. During flood, straw, rice polish, bran and oil cake should be supplied to cattle as feed.
5. Water hyacinth, dal grass, herb-shurb, even banana tree may also be provided to cattle in that time.
6. Hay and silage can be provided as the replacement of green grass.
7. Various varieties of grass seed can be spread on fallow land after going down of flood water.

8. Vaccines for contagious diseases have to be applied and deworming medicines can be provided.
9. Treatment is to be provided to infected animal according to doctor's advice.

Techniques for protecting livestock for facing tidal waves related problem:

Sea tidal waves in coastal area is a big natural disaster. It may damage the livestock to a great extent by hitting on sea-coastal area in any time of the year. Wide range of sea-coastal area and islands of our country are affected by the tidal waves. So, following works should be carried out to protect livestock devouring from tidal waves.

1. Housing for livestock should be made in high land.
2. Livestock are kept in high shelter immediately after getting signal of tsunami or storm.
3. Dead animals are to be buried after tsunami.
4. In that time, boiled rice liquid, rice gruel, dry straw and concentrated feed can be provided to livestock.
5. Concentrated feed like bran, rice polish, oil cake and required amount of salt need to be provided to livestock.
6. Various tree leaves can be provided to cattle in place of green grass.
7. Treatment of animal should be carried out by making team in the tsunami affected area.
8. Vaccines for contagious disease are to be provided to cattle regularly.
9. Care should be taken so that livestock animals may not be affected by disease after taking polluted water.

Exercise

Short Answer Questions

1. What are the effects observed on crop production due to climate change?
2. Make a list of different cold, drought, salt and water logging tolerant crop varieties.
3. What do you mean by crop adaptation?
4. What are the flood related problems occur in livestock for climate change?

Descriptive Questions

1. What are the effects observed in crop production due to climate change in Bangladesh? Describe the effect of drought on crop production.
2. Explain the adaptation of drought in crops.
3. Describe which adaptation technology can be followed against climate change in fisheries sector?
4. How adaptation of livestock can be done in adverse environment? Describe.

Multiple Choice Questions

1. Which one is the prerequisite for crop production in adverse environment?
 - a. Suitable crop selection
 - b. Right land selection
 - c. Proper caring
 - d. Much amount fertilizer application
2. Which one is popular Ropa Aman variety in Khulna and Bagerhat?
 - a. Balam
 - b. Dishari
 - c. Chandina
 - d. Mukta
3. In crop production of our country, climatic change causes-
 - i. to increase disease
 - ii. to increase organic matter.
 - iii. to decrease the fertility of land.

Which one is correct?

- a. i and ii
 - b. i and iii
 - c. ii and iii
 - d. i, ii and iii
4. Which one is halophytes type plant?
 - a. Bean
 - b. Cotton
 - c. Kaora
 - d. Bain

Read the following paragraph and give answer to the question no. 5 and 6:

Taher Mia lives in Netrokona district. In Amon season, expected yield of rice would not be obtained for being under water for 10-15 days at their primary growth stage. Besides, very often ripen boro rice go under water by mountain rain.

5. Through which variety of rice cultivation, Taher Mia will get expected yield in Aman season?
 - a. Kiron (B-R 22)
 - b. BRRI rice 51
 - c. BRRI rice 45
 - d. BRRI rice 36
6. To protect ripen rice from damage in Boro season, Taher mia should do for
 - i. planting seedlings in right time
 - ii. using of BRRI rice 28 and BRRI rice 45
 - iii. using of BRRI rice 51 and BRRI rice 45

Which one is correct of the following?

- a. i and ii
- b. i and iii
- a. ii and iii
- b. i,ii and iii

Creative Questions

1. Sujit Babu's house is in the Shatkhira district belongs to coastal area. He failed to produce rice by cultivation of its local variety in cultivable land. After that, he decided to cultivate BINA rice-8 by taking advice from Agricultural Officer. One day, Sujit Babu came to know many information about the cultivation procedure of different salt tolerant crops by watching a documentary shown by agricultural extension department
 - a. What is called salt tolerant crop?
 - b. How temperature hampers agricultural production? Explain.
 - c. Describe whether the decision taken by Sujit babu is right or wrong.
 - d. Evaluate the activities of agricultural extension department in Sujit Babu's area.
2. Chitra's father has regularly been collecting fish eggs from the Halda river in Chittagong and selling these eggs. But, this year, Chitra's father said with frustration that it would not be possible to collect the eggs of carp type fish within the specific time.
 - a. What is called weather?
 - b. Explain a harmful side for adverse effect of environment.
 - c. Explain why Chitra's father could not collect eggs.
 - d. Explain the effect of procession mentioned in the paragraph on increasing of agricultural production.

Chapter Four

Agricultural Production

Agricultural production means the production of various field crops, horticultural crops, medicinal plants and rearing of livestock and poultry etc. It is necessary to increase agricultural production to keep human life running. Flowers, fruits and vegetables can be cultivated in the fallow and unused lands of Bangladesh in planned way. Besides, by adopting crop rotation, mustard or black gram after cereals, cereals after fiber crop can be cultivated. Beside these, bamboo, jute stick, straw, coconut husk etc. have special importance as the raw materials of industries in this country. Therefore, it is essential to have knowledge about agricultural productions.



Fig. : Rice hills



Fig. : Jute plants

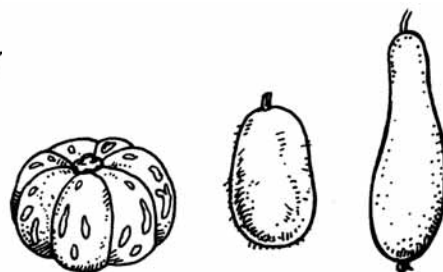


Fig. : Vegetables (sweet gourd, white gourd, bottle gourd)

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

- learn the names of the various types of crop suitable for cultivation, their production technique, pest management and explain their economic importance.
- learn about techniques of vegetable production, pest and their control methods and can explain the economic importance of vegetable cultivation.
- learn about cultivation technique of various flowers and fruits, pests and control methods and can explain the economic importance of the cultivation of flowers and fruits.
- learn about methods of pisciculture, identification of fish diseases and their management and can explain the economic importance of pisciculture.
- learn about methods of livestock and poultry raising, identification of diseases and their management and can explain the necessity of raising livestock and poultry.
- explain about integrated cultivation technique and can describe the different methods of integrated cultivation.
- describe the fish health management of integrated cultivation technique and describe the systems of integrated cultivation technique.

- describe the characteristics, uses and the importance of agro- materials used in industries.
- identify medicinal plants and explain the necessity of medicinal plants.

Section-1

Techniques of Crop Production

We have learnt about the production technique of wheat in class VIII. In this section, we shall learn about the varieties and production techniques of rice, jute, mustard and black gram.

Cultivation of rice

Land selection: Among the cereals, the cultivation and production of rice is the highest in Bangladesh. Because, in Bangladesh, the staple food is rice. The yield of rice is not good in all types of land. The yield of rice is not so good in medium low land and low land. Rice can also be cultivated in medium high land. But in that case, it is necessary to ensure irrigation facilities. Clayey or silt- loam soils are suitable for rice cultivation.

Rice varieties: There are three types of rice varieties in Bangladesh. Such as-

- a) **Local varieties:** Tepi, Girbi, Dudhsar, Ratishail.
- b) **Local improved varieties:** Kataktara, Kalizira, Hasikalmi, Nizershail, Ratishail, Binashail etc.
- c) **High yielding varieties (HYV):** Many high yielding varieties (HYV) of rice are cultivated in Bangladesh. The high yielding varieties of rice have some common characteristics. Such as:
 1. Plants are stout and leaves are erect.
 2. Plants remain green although the rice grains of panicles become ripened.
 3. Plants are short and cannot be lodged.
 4. Production or rice grain is higher than that of straw.
 5. Insect and disease infestation is lower.
 6. Higher numbers of tiller initiation.
 7. Fertilizer uptake capacity and yield is higher.

When necessary, special character, such as- tolerance to pests, shorter life cycle, fine rice grain, tolerance to drought, salinity and submergence etc. are manipulated in the HYV rice then it is known as modern rice. For that reason, all HYV rice are not modern rice, but all modern rice are HYV.

Bangladesh Rice Research Institute (BRRI) has developed 56 HYV of rice by different methods. There are three seasons of rice. These are- aus, aman and boro. There are some BRRI developed rice varieties which can be cultivated both in aus and

boro seasons. Such as- BR 1 (Chandina), BR 2 (Mala) , BR 9 (Sufala), BR 14 (Gazi). BR 1 and BR 2, these two varieties, can also be cultivated in aman season. The number and name of rice varieties released for three seasons are cited below:

- a) **Aus varieties:** There are eight varieties that are cultivated only in aus season. Some of these are BR 20 (Nizami), BR 21 (Niamat) etc. These varieties can be cultivated in aus season by sowing or transplanting. The suitable time for sowing seed in this season is 15- 30 Chaitra and seedling age for transplanting is 20- 25 days.
- b) **Aman varieties:** There are twenty five varieties that are cultivated only in aman season. Some of these are BR 5 (Dulavog), BR 11 (Mukta), BR 22 (Kiron), BRRIdhan 56, BRRIdhan 57 etc.

All these varieties are cultivated by transplanting method and seedling age for transplanting should be 25- 30 days.

- c) **Boro varieties:** There are thirteen varieties that are cultivated only in boro season. Some of these are BR 18 (Shahjalal), BRRIdhan 28, BRRIdhan 36, BRRIdhan 45, BRRIdhan 50 (Banglamoti), BRRIdhan hybrid 1, BRRIdhan hybrid 2, BRRIdhan hybrid 3 etc. Seedling age for transplanting should be 35- 45 days.

Besides these, there are some other varieties of rice. Such as- Rain tolerant, drought tolerant, salinity tolerant, haor, cool tolerant varieties etc.

Seed selection: Clean, healthy and filled seeds, having minimum 80% germination capacity, should be selected for sowing in the seed bed. Seeds are selected by the following method:

At first 375 g urea fertilizer is mixed with 10 liter of clean water to prepare urea salt solution. Then 10 kg seeds are emerged in the solution and are stirred with the hand, consequently filled seeds are deposited on the bottom and the unfilled, light seeds are being floated on the water. Floated seeds are separated by hand or sieve and the good seeds are collected from lower portion of water. These seeds should be washed in clean water for 3- 4 times. The urea mixed water can be used in the seed bed as fertilizer.

Seed treatment and seed sprouting: If the selected seeds are free from any spot and are filled, seed treatment is not required. If seed treatment is required, deeping seeds in warm water of 52- 55°C (hand tolerable) for 15 minutes can be made the seeds free from pathogens. Besides, seed treatment can be done by 30 g Agrosan GN or 20 g Agrosan M for one kg rice seed.

For sprouting seeds, 2-3 layers of straw are made on the bamboo basket or drum. Then the seed bags are kept on the straw layer, thereafter the seed bags are covered with 2-3 layers of straw or aroid leaves. Then these are kept under pressure with a heavy material. Seeds are sprouted within 48 hours or 2 days in aman season, 72 hours or 3 days in boro season and these sprouted seeds become suitable for sowing in the seed bed.

Seed bed preparation: Generally four types of seed beds are prepared for raising rice seedlings. These are-

- a) Dry seed bed b) Wet seed bed c) Dapog seed bed d) Floating seed bed

Dry seed bed is prepared in the high land having loamy soil, and wet seed bed is prepared in the low land having clayey soil. Floating and dapog seed beds are prepared in the flooded areas. The lands having sufficient light and aeration, which do not go under flood or rain water, are selected for seed bed preparation. About dry and wet seed beds are described here:

- a) **Dry seed bed:** The land selected for seed bed preparation should be fertile. The land should be made well pulverized and leveled by 4/5 ploughings followed by ladderings. The soil must have proper moisture level. If necessary, irrigation water should be supplied. Before this, it is necessary to remove weeds from the land. Organic fertilizers should be applied if the land is unfertile. It is better not apply chemical fertilizers in the seed bed.

Measurement of seed bed: Two pieces of beds can be prepared in one decimal land. Each seed bed size is 10m×4m and excluding drain the size is 9.5m×1.5m. Surrounding the seed bed, it is necessary to keep 25 space and between two piece of bed, it is necessary to keep 50 cm space for drain. Seeds should be sprouted before sowing in the seed bed. Sprouting duration of seeds depends on the variety of rice, e.g., 24 hours for aus, 48 hours for aman. For one decimal seed bed, 3 kg seeds should be sprouted in accordance with the procedure mentioned above. Thereafter, the sprouted seeds should be sown in the seed bed.

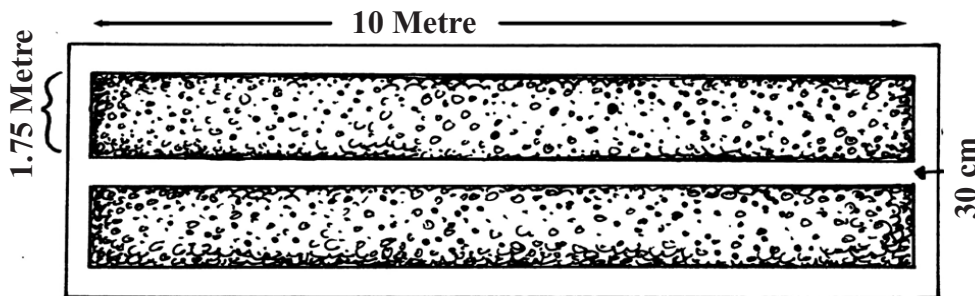


Fig. . Layout of rice seed bed in one decimal land.

The soil between two beds should be lifted and kept on the beds to take care of seedlings and drained out excess water. Thereby the two beds adjacent to drain become high. Then, 60- 80 gm seeds per square meter of seed bed are broadcasted and covered with soil. The beds should be made level with the help of bamboo or flat wooden stick. The drain created between the two beds is essential for irrigation, drainage and fertilizer or pesticide application.

- b) **Wet seed bed:** In this case, the land should be irrigated and thereafter kept for 6-7 days after 2-3 ploughings followed by ladderings. Consequently, weeds and stubbles of the land undergo decomposition and become organic fertilizer. Thereafter, the soil is made muddy by 2-3 ploughings followed by ladderings. It is better to sow seeds by sprouting inside the homestead. The measurement of the wet seed bed is similar to dry seed bed.

Cultural operations in the seed bed: 1) Immediately after sowing, protective measures were taken against poultry, birds, live stocks etc. for 4- 5 days. 2) Measures should be taken to keep water in the drain between the two beds so that not to become dry the seed bed. 3) Thereafter appropriate irrigation water should be applied to the beds from the drains. 4) The weeds, if grown in the seed bed, should be removed. 5) Proper measures should be taken against the diseases and insects in accordance with the suggestions of the agriculture officer. 6) If the seedlings in the seed bed become yellowish, 7 g urea per square meter of seed bed should be applied. 7) If the seedlings remain yellowish after urea application, one should consider that there is a deficiency of sulphur in the seed bed soil. In that condition, 10 g gypsum per square meter of seed bed should be applied by top dressing. 8) The seedlings may be injured due to excessive coolness. For that reason, the seedlings should be covered with polythene at night and should be open at day. This technique will increase the quality of the seedlings.

Uprooting of seedlings:

1. It is better to wet the soil of the seed bed by irrigation water. This made the seed soil soften. Consequently, the uprooting of seedlings becomes easier.
2. Insecticide should be applied if the rice seedlings become infested with insects.
3. Care should be taken so that the base or stem of the seedlings would not be broken.
4. The seedlings should be tied into small bundles after uprooting.

Seedling transportation and preservation: In case of direct transplanting-

1. Leaves and stems should not be rolled during transportation after uprooting seedlings from the seed bed.
2. Seedlings should be arranged in rows in a basket or bamboo basket during transportation.
3. Rice seedlings should never be transported by a closed sac.
4. If direct transportation of seedlings is not possible, the bundles of the seedlings should be preserved in little water under shade.



Fig. . Uprooting of seedlings from the seed bed

Land preparation: The land should be made muddy and level by 4- 5 ploughings followed by ladderings. In that case, the surroundings of the land should be cut with a spade.

Fertilizer management: To get higher yield the land must be fertilized. Besides, since the high yielding rice varieties uptake higher amount of nutrients from the soil, it is essential to apply fertilizer. Cowdung or compost manures should be incorporated with the soil during land preparation. Except urea all other chemical fertilizers such as- TSP, Mp, gypsum, zinc etc. should be applied before final ploughing and should be incorporated with soil during final land preparation. Urea fertilizer should be

applied in three equal splits after transplanting of seedling. First installment should be applied after 15- 20 days of transplanting, second installment after 30- 35 days of transplanting i.e., 4- 5 tillering stage and the last installment after 45- 50 days of transplanting i.e., 5- 7 days before booting stage.

The amount (g) of Urea, TSP, MP, gypsum and zinc fertilizer per decimal area is given below based on the variety and season:

Variety	Season	Urea	TSP	MP	Gypsum	Zinc
Nizami, Niamat	Broadcast aus	50	300	160	240	40
Chandina, Purbachi, Gazi, Bribalam	Transplant aus	540	360	160	240	40
Biplob, Asha, Sufala, Mayna, Mohini, Shahibalam		600	360	160	240	40
Biplob, Progoti, Mukta, Brishail	Transplant aman	600	360	160	240	40
Kiron, Dishari (Late)		360	360	160	240	40
Biplob, Asha, Sufala, Mayna, Mohini, Shahibalam	Boro	840	500	280	280	40
Hasi, Shahjalal, Mangal (for haor areas)		540	360	160	240	40

Applying 20 kg decomposed cowdung or compost, higher yield may be achieved.

General rules for fertilizer application: Beside variety and season, there are some other rules that should be followed during fertilizer application. For example:

1. Higher zinc fertilizer should be applied in the Ganges floodplain and irrigation project areas.
2. All fertilizers should be applied in lower amount in haor areas.
3. Local varieties requires half amount of fertilizers.
4. One- third chemical fertilizers can be reduced if 4- 5 tons per hectare of dry decomposed organic fertilizer or compost is applied. Organic fertilizers should be applied during first ploughing.
5. If the previous crop receives TSP, MP and gypsum at recommended doses, the existing crop requires half amount of recommended doses of these fertilizers.
6. MP fertilizer should be applied in two installments in sandy soil.
7. If one crop receives zinc fertilizers/ zinc sulfate, the succeeding two crops do not require these fertilizers.
8. The land in which green mauling crop is cultivated, the succeeding crop requires only half amount of recommended urea fertilizer.

Transplanting of seedlings: It is better to transplant 25- 45 days old seedlings in the leveled and plain land depending on the variety and season. The seedlings should be transplanted in rows with the help of rope keeping little water in the land. The distance between rows should be 25 cm and between hills in rows should be 15 cm. In each hill, 2- 3 seedlings should be transplanted. If transplanting late, spacing should be lower and number of seedlings per hill should also be higher.

Cultural operations: a) Irrigation: Irrigation water should be applied by flood method if the land is leveled; but if the land is slopping, border strip irrigation method should be adopted for irrigation. Boro rice is fully dependent on irrigation. Measure should be taken to supply irrigation water if the water goes below 5- 7 cm in the land. If water depth goes below 6-7 cm soon after seedling transplanting, irrigation water should be supplied. Up to 6- 7 days seedling transplanting, 3- 5 cm irrigation is necessary. Thereby weeds are controlled. Thereafter, it is better to apply 3- 5 cm irrigation water at tillering stage and 7- 10 cm irrigation water at 50- 60 days of seedling age. The important stage for irrigation is the booting stage. Irrigation is necessary when the grain filling is started.

b. Weed control: At least three times weed control is necessary in the rice field. Such as:

1. Within 10- 15 days of seedling transplanting.
2. Within 14 days of first weeding.
3. Before booting stage.

Generally, Swamp rice, Paspalum grass, Bernyard grass etc. infest the rice field. The should be controlled directly by hand/ nirani or by applying herbicide.

c) Insect control: There are many insects that infest rice field. The yield of rice is reduced considerably due to the infestation of these insects. Generally, Stem borer, Rice hispa, Brown plant hopper, Rice bug, Gall fly, Rice ear cutting caterpillar etc. are found in the rice field.

The identity and control measure of some insects are described below:

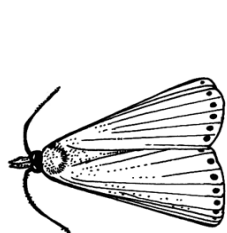


Fig. : Stem borer moth



Fig. : Rice hispa

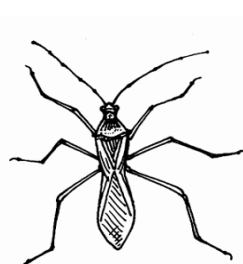


Fig. : Rice bug



Fig. : Green leaf hopper

The insect can be controlled as following tables by applying insecticides based on symptoms of infestation:

Table 1:

Name of the insects	Symptoms of infestation
1. Stem borer	1) Damage middle twig and panicle of rice plant, 2) If infests at tillering stage, middle twig become white, 3) If infests at flowering stage, white unfilled grains found in the panicle, 4) Infests more or less in all seasons.
2. Rice hispa	1) Caterpillar of rice hispa bores and eats the brown portion inside the leaves, 2) Adult insects eats the green portion of leaves, consequently leaves become white.
3. Gall fly	1) Larvae of gall fly infest growing tillers of rice plant and the infested tillers look like onion leaves. 2) Infested tillers do not bear panicle.
4. Rice bug	1) Rice bug infests rice grain at milk stage 2) Bad smell creates from the adult insects.
5. Brown plant hopper	1) Suck juice from base of the rice, 2) Plants die by showing burning color, it is called hopper burn.

Table 2:

Name of the insects	Name of the insecticides
Rice bug, Rice hispa, Stem borer, Gall fly, Mealy bug, Leaf roller, leaf hopper	Sumithion 50 or Malathion 57 or MLT 57 or Diazinon 60
Brown plant hopper	Basudin 10 or Furadan 3 or Diazinon 14
Ear cutting caterpillar	Vapona 100

Disease control: There are many diseases that infect rice plant. Fungi, viruses, bacteria etc. are the causal micro- organisms for these diseases. The causes, symptoms and control measures of some diseases are described below:

Besides, leaf blight, ufra, sheath blight, bakaney, brown spot, sheath rot smut etc. diseases are found in rice crop.

Name of the diseases	Cause	Symptoms	Control measure
1. Blast disease	Fungus	<ol style="list-style-type: none"> 1) Oval spots appear on the leaf 2) Surroundings of the spots become deep brown and the center becomes ash color. 3. When many spot are mixed, then leaves are die. 	<ol style="list-style-type: none"> 1) Use of disease- free seed. 2) Top dressing of potash fertilizer. 3) Sowing seeds by treating seeds. 4) Holding water in the land. 5) Applying manure in the land. 6) Transplanting disease resistant rice varieties such as BR 3, BR 14, BR 15, BR 16, BR 24, BRRIdhan 28.
2. Tungro disease	Virus	<ol style="list-style-type: none"> 1) Tungro disease may appear within one month of of transplanting seedlings. 2) On infestation, at first leaf color becomes light green, thereafter gradually becomes yellow. 3) On pulling the plants easily be uprooted. 4) There is no tiller. 5) At first this disease is found in one or two hills, thereafter it is dispersed to the surrounding hills gradually. 	<ol style="list-style-type: none"> 1) Leaf hoppers disperse this disease, so leaf hoppers have to be controlled. 2) Cultivation of disease resistant varieties such as- Chandina, Dulabhog, Brishail, Gazi, BR 16, BR 22, BRRIdhan 37, BRRIdhan 39, BRR dhan 41, BRRIdhan 42. 3) Killing green leaf hopper by light Trap. 4) By uprooting diseased plants and inserting them in the soil. 5) Spraying Malathion 50 EC.

Task: The teacher will ask the learners to prepare album by collecting different beneficial and harmful insects of rice crop. In this case, the teacher will provide the rules of collecting insects and preparing album.

Crop harvesting, threshing and preserving:

The crop will have to cut whenever the rice grains become ripen in the panicle. If the crop is harvested at over maturity condition, many rice grains are shattered, the panicle becomes break, may infested by rice ear cutting caterpillar and birds. Rice is considered ripened when the brown rice of the 80% rice grains at the upper part of panicle become hard and transparent, and 20% brown rice of the rice grain at lower part of panicle become partially hard and transparent. It is necessary to thresh out the rice grains as soon as possible without left them in the field. During threshing on katcha threshing floor, chatai, chot or polythene have to be broaden on the floor. The color of rice grain remains bright and clean on threshing rice such way. After threshing, rice grains have to be dried in full sun light for 3- 4 days. Now, grains have to be preserved by winnowing well with the help of a winnowing fan. The pot in which rice have to be preserved be filled well. During preserving, if neem/ nisinda/

bishkatali leaf (dust) are mixed, the insect infestation become lesser. Thereafter, the opening of the pot has to be tied well so that air cannot enter inside the pot.

Yield: Yield of aman is higher than aus; that of boro is again higher than aman. It is remarkable that the yield of high yielding varieties is higher than those local varieties. The per hectare yield of HYV rice is 5- 6 tons and per decimal (40 square meters) is 20- 24 kg.

Task: Learners will submit a report preparing on the economic importance of rice cultivation.

Cultivation of jute

Jute grows very well in the fertile plain lands originated by the siltation of the Brahmaputra, the Jamuna, the Meghna etc. rivers in Bangladesh. Besides Bangladesh, jute grows in India, China, Japan, Thailand, Myanmar, Egypt and Brazil etc. Jute industries have been developed in Bangladesh based on the jute production.

Land selection: The fertile loamy soil is the most suitable for jute cultivation. But jute can be cultivated in all types of land except sandy and clayey soil. The land in which silt is deposited at the later period of rainy season is suitable for jute cultivation. Tosha jute can be cultivated in high land and deshi jute in both high and low land.

Jute varieties suitable for cultivation: Each crop has such types of varieties, which have yielding ability, environmental suitability, resistant to insects and diseases, morphological features (size, shape, color), nutritional quality, food value, processing etc. qualities. But it is not possible to manipulate all the characters in optimum level in the same variety. After establishment, till date the Bangladesh Jute Research Institute (BJRI) has developed and released 17 deshi jute, 16 tosha jute, 2 kenaf 1 mesta varieties.

Varieties of deshi jute: CVL 1 (Ggreen jute), CVE- 3 (Ashu jute), CC- 45 (Jeo jute), D- 154, Atom pat- 38 etc. are the varieties of deshi jute.

Varieties of tosha jute: O- 4, O- 9897 (Falguni tosha), CG (Chin sura green) etc. are the varieties of tosha jute.

Varieties of kenaf: HC- 2 (Joli kenaf), AEC- 95.

Variety of mesta: HC- 24 (Tani mesta).

Land preparation: Just after one or two shower of rain in the month of Falgun-Chaitra, the jute field should be ploughed. Land should be ploughed just after harvesting of rabi crops. The land should be leveled after breaking clods by 5- 6 ploughings followed by ladderings. The soil should be well pulverized and the weeds or the roots of the previous crops should be uprooted as the jute seeds are small. Otherwise, the seed germination and emergence will not be expected.

Fertilizer application: Jute yield can be easily increased by applying appropriate amount of fertilizer at appropriate time. If applied at appropriate time, the lower amount of chemical fertilizer is required. But if there is no lack of zinc and sulfur in soil, it is not necessary to apply gypsum or zinc sulfate.

Fertilizer application after 6-7 weeks of seed sowing: At first land should be made weed free with the help of nirani. Then, 50 kg urea per hectare should be applied for all jute varieties except O-9897 and 100 kg urea for O- 9897. This fertilizer should be mixed with some dry soil and should be broadcasted, thereafter; fertilizer should be mixed with soil with the help of 'hoe' or nirani. It should be noted during second time urea application that the applied fertilizer does not come in contact with young leaves and twigs. Soil should have sufficient moisture content during fertilizer application.

Seed treatment: It is better to treat seed before seed sowing. Seed treatment should be done by mixing 20 g Agrosan GN or Captan 75% per kg seed.

Time of seed sowing: If jute seeds are not sown in proper time, plants flower untimely; yield is reduced and fiber quality of jute is deteriorated. Depending on the variety, jute seed can be sown from 15 February to mid April.

Methods of seed sowing and seed rate: Jute seeds can be sown in rows or by broadcasting. If sown in rows, requires lower amount of seed. The distance between rows should be 25- 30 cm and between seed in rows should be 7- 10 cm. If broadcasted, higher amount of seed is required. It should be noted that seeds are not sown in much depth. The seeds should be sown when there is 'Jo' condition in soil.

Cultural operations after seed sowing:

Thinning and weeding: The weak seedlings from densely populated seedlings should be removed after 15- 20 days of seed sowing simultaneous with weeding. After 35- 40 days of sowing 2nd and after 45- 50 days of sowing 3rd time weeding should be done simultaneous with soil loosening.

Irrigation and drainage: From the jute field, irrigation water should be supplied at drought condition and excess water should be drained out at water stagnant condition.

Insect control: Jute hairy caterpillar, mole cricket, jute weevil, jute semilooper, mites etc. in can infest the jute field. The names of some insects, nature of damage and control measures are described below:

a) Jute hairy caterpillar: Symptoms: This insect eats all types of young and matured leaves. The female moth lays eggs on the dorsal surface of the leaves in batch. The young larvae, after hatching, remain on the dorsal leaf surface in groups up to 6- 7 days of hatching. Thereafter, they spread all over the plant. The larvae eat the green portions of leaves when they are in groups and the leaves look like white thin membranes, which are easily observed from the far. They eat the young twigs when the infestation is severe.

Control measures:

1. The leaves with eggs should be removed and damaged whenever found.
2. At the early stage of infestation when the larvae remain in group the leaf with insects should be killed pressing by legs, in pit or by in dipping in kerosene mix water.
3. The pupae remains under the soil come out whenever the dry land is ploughed after cutting jute and these pupae are damaged by birds.
4. A protective canal can be made surrounding the infested field and kerosene mix water can be kept in the canal to protect the spreading of jute hairy caterpillar to the uninfested field.
5. The insecticides should be applied in accordance with the suggestion of the agriculture officer.

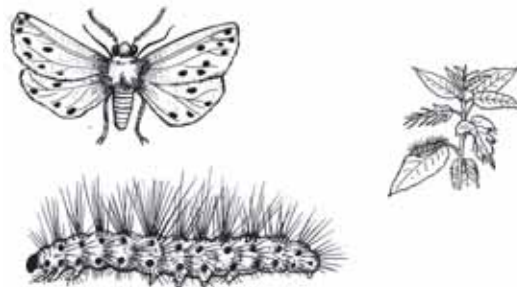


Fig. : Jute hairy caterpillar and jute plant

- b) Mole cricket: Symptoms:** These insects make holes in the land and live inside the holes at day. At night, they come out from the holes, cut the base of the jute seedlings and keep the cut seedlings inside the holes. Consequently, the jute sometimes becomes vacant with jute plants. The infestation becomes higher when there is no rainfall and the infestation becomes lower after rainfall. The adult insects eat the root and the base of the stem of jute plants.



Fig. : Mole cricket

Control measures:

1. The land in which the infestation is higher each year, the seed rate should be higher for that land.
2. In the infested land, when the seedlings become 8- 9 cm, densely populated plants should be thinned out.
3. If possible, measures should be taken to supply irrigation water from the nearby water source.
4. Measures should be taken to apply insecticide in accordance with the suggestion of the agriculture officer.
5. Insecticides should be applied in the holes.
6. Should be applied poison bits of insecticides.

- c) **Jute semilooper: Symptoms:** The jute semilooper infests the young twigs and leaves of the jute plants. Consequently the young leaves become damaged and branching occurs in the jute plants. Therefore, jute yield is reduced and fiber quality is deteriorated.

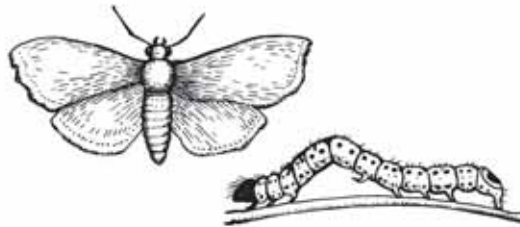


Fig. : Jute semilooper

Control measures:

- 1) When infestation is found, kerosene mixed rope should be pulled over the jute plants. This will reduce the infestation of the insects.
- 2) The birds Shalik or Mayna like to eat jute semilooper. Therefore, to sit these birds, bamboo sticks or small branches of trees should be placed in the jute field.

- d) **Jute weevil: Symptoms:** The female insects lay eggs by boring the twigs of jute seedlings. After hatching, the nymphs go inside the plant and become adult there. Consequently, the twigs become die the plants bear branches. If the plants become matured, the insects lay eggs inside the stem by boring near the base of the leaves. Consequently, there creates a knot like structure. During jute retting, these knots do not undergo retting. The fiber bears black spots on that places and thereby the fiber quality and price become reduced.



Fig. : Jute weevil

Control measures:

- 1) The weeds near the jute field should be cleaned before seed sowing and after cutting of jute.
 - 2) The infested jute plants should be removed and be destroyed.
 - 3) The insecticides should be applied in accordance with suggestion of the agriculture officer whenever the plants become 5- 6 cm in height.
- e) **Mites:** There are two types of mites found in the jute field. Such as- yellow mite and red mite.

Symptoms: The yellow mites infest young leaves and suck leaf juice. Consequently leaves become rolled and leaves color become coppery. The yellow mites also attack flower buds. Consequently flower buds cannot bloom. Petals color become yellow to black and shaded. Therefore, the seed yield is reduced. The infestation of these insects become higher when there is a continuous drought or rainless. The red mites infest comparatively the lower leaves.



Fig. : Red mite

Control measures:

- 1) Lime and sulfur should be mixed by 1:2 ratio and should be applied in the infested field with water.
- 2) Green leaf juice of neem mixing with water by 2: 5 ratio should be applied in field.
- 3) The insecticides should be sprayed in accordance with the suggestion of the agriculture officer.

Task: The learners will prepare an album of beneficial and injurious insects of jute crop in groups. In this case, the teacher will give instructions on the insect collection and procedure of album preparation.

Disease control: Stem rot, black band, foot rot, dry rot, wilting etc. are the diseases found in jute. The symptoms and control measures of some of these diseases are described below:

- a) **Stem rot disease: Symptoms:** Deep brown spots are found on the leaves and stems of jute plants. The spots can be found on anywhere from the base to tipoff the jute plants. Numerous black dots are found on the spots. The pathogens fungi remain on the black spots. This disease can be found in kenaf and mesta pat.
- b) **Black band:** The symptoms of this disease almost similar to that of stem rot disease. But a black band surrounding the stem is found. By rubbing on these spots black dusty spots are found on the hand. Consequently, plants dried and die.
- c) **Dry rot:** This disease is found only in the deshi jute. The seedlings die when infection occurs at the seedling stage. The black spots are found on the stem of the mature plants. The infected place is cracked and pathogens are found on the cracked place. The pathogens fly on the air and infect the fruits. The infected fruits become black and small in size. The plants do not die due to this disease but the infected place becomes hard. For that reason, the fiber of the infected place remains on the jute stick after retting. This fiber is of low quality.

Control measures: Stem rot, black band and dry rot, all the three diseases are seed, soil and air borne. The control measures of these diseases are similar. Such as:

- 1) The weeds, stubbles and roots of the previous crop should be uprooted and burnt after cutting of jute.
- 2) Seeds should be treated before seed sowing.
- 3) The jute seeds should be collected from the healthy plants.
- 4) Measure should be taken to drain out excess water all time.
- 5) Measures should be taken to control diseases just after appearing of the diseases.
- 6) Insecticides should be sprayed.

Cutting of jute and making bundles: The quality and yield both are reduced if jute is not cut at proper time. Generally, deshi jute is cut in the month of Ashar- Shrabon and tosha jute is cut in the month of Shrabon- Bhadra. The proper time of jute cutting is when the plants are in flower. The cut plants are tied into bundles of about 10 kg just after jute cutting. After making bundles, these are kept in field for 3- 4 days, thereby the leaves become shaded. The leaves should be spreaded in the field as the jute leaves are good manures.



Fig. : Jute cutting and making bundles

Jute rafting:

At first 10- 15 jute bundles are arranged on water keeping the base of the plant at the same direction; thereafter some other jute plant bundles are arranged by keeping the base at the opposite direction of the previous bundles. This is called the jute raft. Care should be taken that 30 cm water remains above the raft and 60 cm below the raft. Broadcasting 1 kg urea per 100 bundles of jute plants accelerates jute rotting and improves the quality of jute fiber. The clean water of bills, canal or rivers having low current is the most suitable for jute rafting.

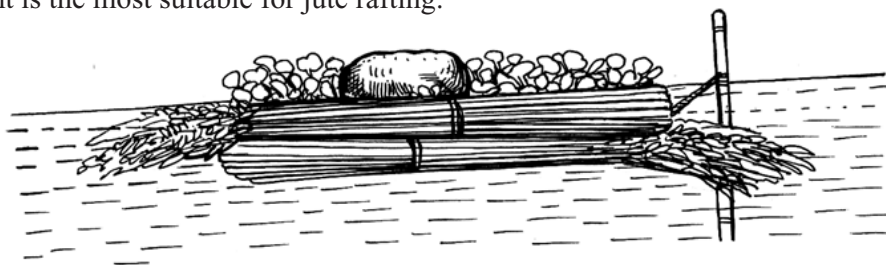


Fig. : Rafting of jute

For steeping of jute raft, soil clods, banana plants, mango plants etc. should not be used. Because these make the fiber color black. The jute raft is steeped in water by tying with the bamboo stick or by pressing with stones. To cover the raft, water hyacinth, straw can be used.

Determining time of jute rotting:

The jute rotting should be examined from 10- 11 days after steeping of jute raft. Generally, 4- 5 jute plants are pulled out from the raft. If the fiber from these plants can easily be separated, then it indicates the completion of jute rotting. The jute rotting is completed within 12- 14 days in warm weather and within 20-25 days in cool weather.

Separation and cleaning of fiber: Fiber can be separated from the plants by two ways after rotting. Such as-

- 1) The each bundle is lifted above the water and kept in dry place. The fiber from each plant is separated by sitting on the dry place. Thereafter fiber separated from some plants are tied together and washed in water.
- 2) By standing in knee or water, the base of the jute plants are bitten with the hammer. Then the fiber of the base are rolled with hand are separated by pushing it front- behind direction parallel with water. Thereafter, the fibers are washed and tied into bundles.

Drying and preservation of fiber: The bamboo made aryl is used to dry jute fiber under high intensity sunlight. If the fiber is dried little, the fiber remain the decomposition of jute fiber is started. This decreases the quality of jute fiber. Therefore, jute should be properly dried and be stored by making bundles.

Yield: Yield varies with the variety. The yield of deshi jute is slightly higher than that of tosha jute.

Importance of jute crop in Bangladesh: Jute is a fiber crop. Jute ranks the highest position among the economic crops produced in Bangladesh. Considering the utility, economic importance etc. of jute, it is called the golden fiber. There exists rainfall whenever the jute crop grows. Therefore irrigation is not required. The jute crop can tolerate both drought and water stagnancy. So, in Bangladesh where there is lack of irrigation facilities and where there is water stagnancy from March to September, jute is cultivated more compared to rice in those areas. Besides, there are about 300- 400 thousand hectares of land in Bangladesh where no crops without jute can be cultivated. Jute suffers lower due to drought, flood, excessive rainfall etc. compared to other crops.

Deshi and Tosha, these two types of jute, are cultivated in Bangladesh. But comparatively cultivation of tosha jute is higher than that of deshi jute. Because, in previous, the areas where jute was cultivated were low lands. Now these areas have gone under rice cultivation due the demand of food. Jute is now cultivated in the high land where dependency on rainfall is higher. However, not only as the fiber crop but jute has also the boundless importance in the field of agro- industries, pharmaceutical industries, and conservation of environment and as vegetables.

Task: Learners will submit a report preparing on the importance of rice crop in economic development.

Cultivation of mustard

Mustard, soybean, sesame, linseed, groundnut, sunflower etc. are cultivated in Bangladesh as oil crops. But the farmers of the country cultivate mustard as the main edible oilseed crop. About mustard cultivation is discussed below:

Land selection: Sandy- loam or silt- loam soils are suitable for mustard cultivation. Therefore, well- drained lands having sandy- loam or silt- loam soil should be selected for mustard cultivation.

Selection of variety: There are many mustard varieties that are cultivated. The name of some released mustard varieties are- Tori- 7, Kalyania (TS- 72), Sonali sarisha (SS- 75), Sampad (M- 12), Rye sarisha, BARI sarisha- 8, BARI sarisha- 14, BARI sarisha- 15, BARI sarisha- 16 etc.

Sowing time: Mustard is a winter crop in Bangladesh. Based on the regional difference and 'Jo' condition seeds of Tori- 7, Kalyania (TS- 72), Sonali sarisha (SS- 75) and BARI sarisha- 8 can be sown from September (mid Ashwin) to October (mid Kartic). The seeds of BARI sarisha- 14, BARI sarisha- 15, BARI sarisha- 16 can be sown from last week of Ashwin to last week of Kartic.

Land preparation: Depending on the land types, the mustard land should be prepared whenever the 'Jo' condition appeared by 4- 5 ploughings followed by laddering so that the soil become pulverized. The soil should be made leveled and dusty by breaking soil clods since the mustard seeds are small. Canals, surrounding the land, should be made so as to facilitate irrigation and drainage.

Rate and methods of fertilizer application:

Based on the difference in variety, soil and soil moisture content compost, urea, TSP, MP, gypsum, zinc sulfate, borax/ boric acid etc. fertilizer should be applied in the mustard following the appropriate rules.

Half amount of urea and all other fertilizers should be mixed well with soil during land preparation. Rest half amount of urea should be applied by top dressing at flowering stage. It is necessary to have appropriate moisture content in soil during fertilizer top dressing.

Seed rate: The mustard varieties Tori- 7, Kalyania (TS- 72), Sonali sarisha (SS- 75) and BARI sarisha- 8 require 8- 10 kg seeds per hectare.

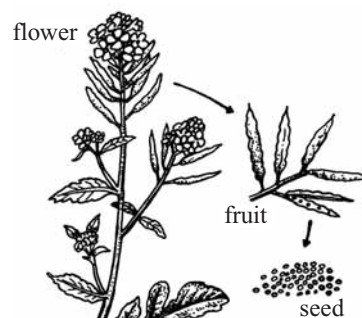


Fig: Mustard plant with flowers and mustard seeds

Methods of sowing: Generally mustard seeds are broadcasted. It is difficult to sow seeds uniformly throughout the land since the mustard seeds are small. For that reason, if the seeds are mixed with sand or ash before sowing, the seeds can be sown uniformly throughout the land. Thus there is a minimum possibility of having un-uniform plant population in the mustard field. Mustard seeds can be sown in rows. This facilitates fertilizer application, irrigation, weeding etc. intercultural operations. In this case, distance between rows is kept 25- 30 cm. In each row, seeds are sown maintaining 4- 5 cm distance and 2- 4 cm depth. Seeds are emerged within 2- 3 days if sufficient soil moisture is present.

Task: The learners will visit the mustard field nearby to the school and will submit a group- wise report on the steps involved in mustard cultivation.

Cultural operations: The following cultural operations are done in the mustard field:

- 1) **Irrigation:** Mustard crop does not require irrigation if moisture content is sufficient. Based on the moisture content, very good yield can be achieved providing 2- 3 irrigations. It is better to provide first irrigation at 20- 25 days after sowing and second irrigation at fruit setting. Land should be prepared providing a light irrigation if the land is dry before sowing. Mustard cannot tolerate water stagnancy. For this reason, it is not ought to allow the irrigation water to create water stagnancy in the mustard field.
- 2) **Thinning:** Densely populated seedlings should be thinned out. The seeds should be re- sown where there is no seeds germinate at all. Thinning should be done 10- 15 days after seedling emergence.
- 3) **Weed control:** No sooner the weeds are found in the mustard field should be uprooted. Weeds can be controlled during thinning. The lands in which the infestation of *Orobunchi* is found, it is better not to cultivate mustard for two successive years in that field.
- 4) **Causes of diseases, symptoms and control measures:** The most important disease of mustard is the *Alternaria* blight or leaf spot. At first, brown and thereafter deep colored round spots are found in leaves due to this disease. To protect the crop from this disease, the seeds should be sown following appropriate rules.
- 5) **Control of insects and mites:** The main injurious insect of mustard is aphid. The young and adult aphids suck juice from stem, leaf, inflorescence, flower and fruits and thereby plants become weak. Flowering and fruit setting are hampered. Fruits become small by shrinking and yield is reduced by 30- 70%. The infestation is the highest in January. To protect from the infestation of aphid, 2 ml Malathion- 57 EC per liter of water should be sprayed in the mustard field with help of sprayer.

Harvesting of crop: Proper harvesting time of mustard is determined when 70- 80% pods of the mustard plants becoming straw color and leaves becoming yellow. It is better to harvest mustard crop at morning in presence of dew. The crop can be harvested by uprooting or by cutting with sickle. But uprooting is better.

Threshing of crop: After harvesting, threshing should be done by drying mustard plants in the sun for 3- 4 days. There may be some unfilled seeds. These unfilled seeds should be separated.

Drying and preservating of seeds: After threshing, seeds are cleaned by winnowing. Thereafter the seeds are dried well in the sun and then preserved in the dry pots. The preserved seeds should frequently be dried and preserved. The sun- dried seeds, if preserved at warm condition, deteriorated germination capacity. For this reason, the sun- dried seeds should be cooled and thereafter be preserved in plastic pots, tins or drums so that the air cannot enter into the pots.

Yield: The average yield of mustard in Bangladesh is 810 kg per hectare.

Importance of mustard crop:

There are three types of mustard cultivated in Bangladesh. Such as- Tori, White and Rye. Depending on variety, mustard contains 40- 44% oil. After extracting oil from the mustard seed, the remaining oil cake contains 40% protein and 64% nitrogen. Mustard oil cake is the nutritive food for cattle, buffalo and high-quality manure. Besides, mustard oil is used for cooking. By rearing honey bee in mustard field artificially, sufficient amount of honey can be collected. For this reason, mustard is also called the honey plant. Therefore, mustard crop is very important in the field of economy, pharmaceutical industries and agriculture.

Task: The learners will submit a report preparing on the economic importance of the cultivation of mustard crop.

Cultivation of black gram

Black gram ranks the fourth position among the pulse crops cultivated in Bangladesh. About 9- 11% of the total pulse production in the country comes from black gram. The cultivation of black gram is higher in the north and north- western regions specially in Chapainababganj. Black gram is a hard and drought tolerant crop which can tolerate high temperature. Beside pulse, it is widely used as feed and green manure in green condition. Therefore, as a pulse crop, black gram is an important one. Now we shall learn about the cultivation method of black gram.

Land selection: Well- drained loamy and loamy soils are suitable for the cultivation of black gram. Black gram can be cultivated in high to low all types of land if there is no possibility of water stagnancy. Black gram is crop of warm and dry climate.

Varieties: There are many improved and local black gram varieties cultivated in Bangladesh. The names of some black gram varieties are given below:

a) HYV: BARI- 1 (Pantho), BARI- 2 (Sharat), BARI- 3 (Hemonta), BINAmas – 1, BINAmas- 2.

b) Local varieties: Rajshahi, Sadhuhati.



Fig : Black gram

Land preparation: It is not necessary to prepare land in well pulverized condition to cultivate black gram. Based on the type of land and soil the land is prepared by 2-3 ploughing and cross ploughing followed by laddering.

Time of seed sowing: Black gram seeds can be sown from last week of February to mid September.

Seed rate: The seed rate for cultivation is given below:

Objectives	Methods of sowing	Seed rate (kg/ha)
Seed purpose	Broadcasting	35- 40
	Line sowing	25- 30
Feed or green manure purpose	Broadcasting	50-60

Methods of seed sowing: Black gram seeds can be sown by broadcasting or by line sowing. But it is better to sow seeds in rows. When sown in rows, 30 cm distance is maintained between rows. The seeds are sown continuously in rows maintaining 2- 3 cm depth. In broadcast method, seeds are spreaded all over the field uniformly during final ploughing and are covered with soil by laddering.

Seed treatment: Seeds should be treated before sowing to control seed- borne diseases.

Fertilizer management: The seed rate for black gram cultivation is as follows:

Name of fertilizer	Amount of fertilizer (kg/ha)
Urea	40- 45
TSP	85- 95
MP	30- 40
Bio-fertilizer	4- 5

Principles of fertilizer application:

- 1) All the fertilizers should be applied during final land preparation.
- 2) Urea fertilizer is not necessary if bio- fertilizer is applied.
- 3) For per kg seed, 80 g bio- fertilizer should be applied.

Task: The learners will visit the black gram field nearby to the school and will submit a group- wise report on the steps involved in black gram cultivation.

Intercultural operations:

1. The weeds found after seedling emergence should be removed by nirani 15- 20 days after emergence.
2. Measures should be taken to drained out excess water if there is a possibility of water stagnancy.

3. After seed sowing, if there is lack of moisture in the land, light irrigation should be given.
4. After irrigation when 'Jo' condition prevails, surface hard layer should be broken.
5. Measures should be taken to control insects and diseases in the crop field if infestations are found.

Disease management:**a) Leaf spot of black gram**

Cause and dispersal of the disease: This disease is caused by the fungus *Cercospora*. This disease is dispersed by the crop residues, air and rain water. This disease is dispersed quickly under high humidity and high temperature.

Symptoms of the disease: Round to oval small red spots are found on the infected leaf. The cells of the infected leaf area become dry and the leaf becomes porous. The entire leaf becomes blight if the infection is severe.

Control: 1) The disease resistant black gram varieties (BARI-1, BARI- 2 and BARI- 3) should be cultivated, 2) No sooner the infection appear, the fungicides should be applied.

b) Powdery mildew disease:

Cause and dispersal of the disease: This disease is caused by the fungus *Oidium*. Generally, the infection of this disease is higher in dry season. This disease is dispersed by the seed, crop residues and air.

Symptoms of the disease: 1) Powdery layer is found on the dorsal side of the leaf. 2) Powdery dusts are felt when touched by hand.

Control: 1) Alternate hosts or crop residues should be burnt. 2) Tilt or Theovit should be applied. 3) Disease free seeds should be sown. 4) Seed should be treated with fungicide before sowing.

c) Yellow mosaic virus:

Cause and dispersal of the disease: This disease is caused by the mosaic virus. This disease is dispersed by the infected seed and crop residues. The white fly acts as the vector of this disease.

Symptoms of the disease:

- 1) At first young leaves are infected.
- 2) Yellow- green spots are formed on the infected leaves.
- 3) The infected field looks yellow away from the field.

Control:

- 1) Disease free seeds should be sown.
- 2) Malathion should be applied to control white fly.
- 3) The infected plant should be uprooted and burnt.
- 4) Crop rotation should be adopted.
- 5) The disease resistant black gram varieties (BARI-1, BARI- 2, BARI- 3 and BINA mas- 1) should be cultivated

Insect management

Black gram field may be infested by caterpillar. These insects eat leaves and juice of immatured fruits. The whole plant along with leaves looks like a net. Consequently yield is reduced. On appearing of the infestation of these insects, they should be collected by hand and be destroyed. If infestation becomes higher, mixing appropriate amount of Symbush 10 EC per liter water should be sprayed.

Beside, the stored black gram grains are also affected by adult insects and larvae. The insects bore the black gram seed coat, enter inside the seed and eat the inner part. Consequently the grains become light. Thus, seeds lost germination capacity and become unsuitable as food. Before storing, the seeds should be cleaned properly and dried bring the seed moisture content below 12%. For seed purpose, insects' infestation can be controlled by mixing 300 g Malathion or Sevin 10% per ton seed.

Harvesting, threshing and storing:

- 1) Crop is harvested at last of May in kharif- I and at the last of October in kharif- II.
- 2) Crop should be harvested at morning after maturity.
- 3) Based on the variety, one or 2- 3 times black gram pods should be harvested.
- 4) Pods should be harvested by hand at earlier harvest and the plants should be cut at base by sickle at the final harvest.
- 5) Seeds should be collected by biting with the stick or by cattle after drying plants in the sunlight.
- 6) After threshing, seeds are cleaned, dried well in the sun. The sun- dried seeds should be cooled and thereafter be stored in plastic pots, tins or drums so that the air cannot enter into the pots.

Yield: Based on the variety, the yield of black gram is 1.5- 2.0 tons per hectare.

Task: The learners will prepare a list of insects and diseases of rice, jute, mustard and black gram and submit to the course teacher.

Section-2

Cultivation Technoques of Vegetables

We can frequently see vegetables in the crop fields, gardens, and markets. We fulfill the demand of vegetables by collecting these from our own land or market. Now we shall learn about the cultivation methods of these vegetables. But before knowing the cultivation methods, it is necessary to discuss the importance of vegetables and the considerations in vegetable cultivation.

1) Importance of vegetable cultivation: Vegetables contain a lot of nutrients. The position of vegetables production and uses have reached at very high level in the improved countries of the world.

Cultivating vegetables by modern techniques, we can fulfill the demand of our family as well as we can earn some money by selling these. Therefore, it is essential to cultivate vegetables as foods, vitamins, minerals and economic crops.



1. Vegetables as food:

Fig: Different types of vegetables.

1.1. As food value: Vegetables contain a lot of vitamin A, B and C. Besides, vegetables have a great importance as the source of protein, calorie and minerals.

1.2. As herbal quality: Vegetables has a great role as herbal quality, such as-cucumber acts in digestion and stiff motion. Garlic used in rheumatism.

1.3. Vegetables as economic view: Vegetables is essential for human body. Everybody should take sufficient amount of vegetables to live with a healthy and strong body. Therefore, cultivation of vegetables can fulfill the demand of our family as well as can earn some money by selling these. By cultivating vegetables, it possible to use fallow lands, earn foreign currency, solve problems of unemployment, establish and develop new industries and manual power of female and family members.

Therefore, from the above discussion, we can say that considering all aspects, vegetables production is profitable and important in Bangladesh.

2. Classification of vegetables: Numbers of plants of the world are used as vegetables. There are about 60 varieties of vegetables cultivated in Bangladesh. Based on the growing seasons, these vegetables can be divided into three classes. These are- (1) winter vegetables (2) summer vegetables (3) year- round vegetables. e. g.,-

Winter vegetables: Tomato, cabbage, cauliflower, bean, carrot etc.

Summer vegetables: Bitter gourd, ribbed gourd, pointed gourd, sponge gourd etc.

Year- round vegetables: Brinjal, lady's finger, papaya, green banana etc.

Task: Teacher will ask the learners to submit a list preparing on winter, summer and year- round vegetables.

Bean, tomato are mainly the winter vegetables. Now a day, one or two varieties have been developed which give yield also in summer. A kalmishak named gimakalmi can be cultivated throughout the year. Cucumber and khira can be cultivated throughout the year. For that reason, these vegetables are called year- round crops.

3. Factors considered in vegetables production: We have learnt above the name of various vegetables with their growing seasons. Now, we shall learn the factors involved in Vegetables production.

The following important factors should be considered before cultivating any crop as well as vegetables.

1) good seed 2) land selection and preparation for seed bed 3) seed sowing and cultural operation in seed bed 4) selection and preparation of the main field 5) seed sowing and transplanting 6) irrigation and drainage 7) weeding and mulching 8) insect control 9) disease control 10) crop harvesting at proper time.

3. Methods of vegetable cultivation: There are various methods of vegetables cultivation practicing in home and abroad. Among these, traditionally used some methods are sequential cultivation method, mixed cultivation method, relay method, strip cultivation method and row cultivation method.

The cultivation methods of some vegetables are described below:

Cultivation of spinach

Spinach is very popular, nutritious and palatable leafy vegetable.

This vegetable is vitamin rich. This vegetable is cultivated in winter in Bangladesh.

Varieties of spinach: Pusha joyonti, kapy palong, green, sabuj bangle sour palong. Besides, there are some other varieties of spinach, such as nobel joint, banerjee joint, pushpa jati etc.



Fig: Spinach

Soil: Loamy fertile soil is very suitable. Besides, spinach can also be cultivated in clayey and sandy- loam soil.

Land preparation: Land should be made well pulverized by ploughing and laddering.

Amount of fertilizer:

Name of fertilizer	Per decimal
Cowdung	40 kg
Urea	1 kg
TSP	500 gm
MP	500 gm

Rules for fertilizer application:

- All fertilizers except urea should be applied during final ploughing. But it is better to applied cowdung at earlier ploughing.
- Urea fertilizer should be applied in 2- 3 installments starting from 8- 10 days after seedling emergence by 10- 12 days' intervals.

‘Aal’ selection and Land preparation: Spinach can be cultivated preparing ‘aal’ in the land. Spinach can be sown some extent early in the high ‘aal’. Weeds should be removed from the ‘aal’ by spading.

Fertilizer application: Recommended amount of cowdung, urea, TSP and MP fertilize should be applied in the spinach land.

Seed rate:

Per ‘Aal’	Per decimal	Per acre	Per hectare
35- 40gm	117 gm	9- 11 kg	25- 30 kg

Time of seed sowing: September – January.

Spacing of seed sowing: Seeds are sown maintaining distance 10 cm. seeds can also be sown by broadcast method.

Time of germination: About 7- 8 days required for germination after seed sowing.

Seed sowing or seedling transplanting: Seeds can be sown directly in the ‘aal’ or in the pit. Besides, spinach can be cultivated by raising seedlings in the seed bed and transplanting these seedlings in the main field. Before sowing, seeds should be dipped in water for 24 hours. Making pits maintaining certain distance, 2- 3 seeds should be sown in each pit.

Task: The learners will visit the spinach field nearby to the school and will submit a group- wise report on the steps involved in spinach cultivation.

Cultural operations:

Weed control: Weeds should be up rooted just after appearing weeds.

Fertilizer top dressing: Recommended fertilizer should be top dressed timely.

Irrigation: This leafy vegetable requires abundant water. For that reason, based on the 'Jo' condition of soil, irrigation water should be applied before top dressing. A light irrigation is required after seedling transplanting.

Gap- filling: Within 7- 10 days, seedling should be replanted where there is no seed germinated or seedling died after emergence.

Soil loosening: After every irrigation the soil should be made loose by crust breaking to facilitate moisture holding and aeration. This operation requires for rapid growth of the plants.

Thinning: After 8- 10 days of seed germination, excess seedlings should be thinned out keeping 2 numbers of seedlings per hill and these seedlings should be used in gap- filling.

Harmful insects: Sometimes ants, mole cricket, termite and leaf borer may infest spinach. If infestation is found, infested plants should be up rooted.

Disease management: Among the principal diseases of spinach, there are- 1) foot rot disease 2) leaf spot disease 3) leaf blight disease.

Crop harvesting: Spinach can be harvested from one month after seed sowing and can be continued till flowering.

Yield:

Per 'Aal'	Per decimal	Per acre	Per hectare
8-10	28-37 gm	2800-3800 kg	7-9 Ton

Cultivation of Indian spinach

Indian spinach is a principal summer leafy vegetable in Bangladesh. But it is available throughout the year. This vegetable is rich in vitamin A, calcium and magnesium. This vegetable is generally found to grow on the fences of households or on matcha.

Varieties of Indian spinach: Indian spinach has two cultivated varieties. These are:

a) Red Indian spinach: Leaves and stems are reddish. b) Green Indian spinach: Leaves and stems are green.

Besides, there are two varieties developed by Bangladesh Agricultural Research Institute. Such as- BARRI- 1 and BARI-2.

Land preparation: Generally March- April or Chaitra is suitable for time for planting Indian spinach. But if irrigation facilities are prevailed, it can be planted from Falgun. Land should be made well pulverized by ploughing and laddering before transplanting seedling. Fertile sandy- loam or loamy soils are suitable for cultivating this leafy vegetable.



Fig : Indian spinach

Fertilizer application: It is better to apply cowdung or compost in Indian spinach cultivation. Thus soil properties can be maintained and environment can be conserved. In Indian spinach, per decimal or 40 square meter of land requires fertilizers as follows:

Name of fertilizer	Per decimal
Cowdung	40 kg
Urea	1 kg
TSP	500 gm
MP	500 gm

Rules for fertilizer application:

- All fertilizers except urea should be applied during final ploughing. But it is better to applied cowdung at earlier ploughing.
- Urea fertilizer should be applied in 2- 3 installments starting from 8- 10 days after seedling emergence by 10- 12 days' intervals.

Seed sowing seedling transplanting: Seeds of Indian spinach should be sown in the month of March – April. It can be cultivated by seed and branch cutting. But it is better to cultivate Indian spinach by raising seedlings by seed and transplanting the seedlings. Indian spinach should be transplanted maintaining distances between lines 60- 80 cm and between seedlings in lines 50 cm. In rainy season, some vines of Indian spinach can be cut and planted in soil.

Cultural operations:

Land should be kept weed free with help of nirani. Regular irrigation should be supplied during drought. Soil should be made loose by breaking crust with the help of nirani after irrigation. Care should be taken not to stagnant water.

Harmful insects: Among the harmful insects of this leafy vegetable, the remarkable one is semilooper. This insects harm by eating leaves and young twigs of the plants.

Crop harvesting and yield: When the twigs of Indian spinach started to become long, the twigs should be cut and collected. This facilitates the development of new twigs. The crop can be harvested by cutting new twigs several times. If cultivated properly, Indian spinach can yield 130- 150 kg per decimal area.

Cultivation of brinjal

Brinjal is a well known vegetable. Brinjal is available all round the year. Beside this country, it is cultivated in India, China, Japan, Pakistan, Philippines, United States, south- European countries.

Varieties: The remarkable varieties are Islampuri, Shingnath, Uttara, Nayankajol, Muktakeshi, Khatkhatia, Taherpuri, Nayantara. There are year- round black and white colored varieties (egg brinjal). Among the foreign varieties, Black beauty, Florida beauty are remarkable.

Seed sowing and raising seedlings: Raising seedlings is an important work for the cultivation of brinjal. Seeds can be sown from mid Shraavan to mid Ashwin for the cultivation of winter brinjal and upto Chaitra for the cultivation of summer brinjal. Seed bed is to be prepared by mixing sand, compost and soil in equal proportion.



Fig : Brinjal plant

Seedlings should be uprooted at 8- 10 days after emergence and planted in the second seed bed.

Land selection: Loamy and sandy- loam soils are the most suitable for the cultivation of brinjal. But brinjal can also be cultivated in clayey and loamy soil if there is good facilities to drained out excess water.

Land preparation: Land should be made well pulverized by 4- 5 ploughing and laddering. To get good yield, the land should be deeply ploughed.

Rules for fertilizer application:

Name of fertilizer	Per decimal
Cowdung	40 kg
Urea	1 kg
TSP	500 gm
MP	500 gm

- All fertilizers except urea should be applied during final ploughing. But it is better to applied cowdung at earlier ploughing.
- Urea fertilizer should be applied in 2- 3 installments starting from 8- 10 days after seedling emergence by 10- 12 days' intervals.

Seedling transplanting: One- month old seedlings should be up rooted with the help of stick. Care should be taken not to injure the roots of seedlings. Thereafter, seedlings should be transplanted maintaining distances between lines 75 cm and between seedlings in lines 60 cm.

Task: The learners will visit a vegetable garden nearby to the school and will submit a group- wise report on the steps involved in brinjal cultivation.

Cultural operations: Irrigation water should be supplied at 10- 15 days intervals if there is deficit moisture in soil or the soil becomes dry. The soil should be made friable with the help of nirani after irrigation. Weeds have to be removed regularly.

Pest management: In this country, about 16 species of insects and one species of mite are harmful to brinjal. Among them, the main enemy of brinjal is the brinjal shoot and fruit borer. The insects bore the twigs and fruits of brinjal. The infested twigs and fruits should be collected and be destroyed. Beside, Malathion or Sumithion is to be sprayed by mixing 10 ml chemical with 10 liter water. Beside these, pests of brinjal can be controlled by adopting the following technologies:

- a) The wilt disease of brinjal controlled by using seedlings prepared from cuttings.
- b) Cucurbit fruit fly can be controlled by using traps of pheromone or sweet gourd.
- c) The soil- borne disease of different vegetables like brinjal, tomato, cucumber, cabbage can be controlled by using by decomposed poultry litter or mustard oil cake.
- d) Yield increases manifold controlling weeds and adopting mulching at proper time.
- e) the brinjal shoot and fruit borer can be controlled by cultivating insect resistant varieties. Such as- BARI brinjal- 1 (Uttara), BARI brinjal- 5(Nayantara), BARI brinjal- 6, BARI brinjal- 7 etc, are the insects resistant varieties.
- f) Seedlings free from insect infestation should be used.
- g) Balanced fertilizers are to be applied.
- h) By adopting crop rotation.

Crop harvesting and yield: Brinjal plant flowers at 30- 40 days after transplanting. Brinjal fruits should be collected before seeds become hard. Generally, per decimal or per 40 square meter yield of brinjal is 140 kg. Uttara brinjal can yield up to 200 kg per decimal area.

Marketing: Brinjal can be preserved in cool and open places for several days. But it is ought to keep brinjal in sac for long time. Thus, brinjal can lost its normal color and be decayed.

Cultivation of pumpkin

Pumpkin is a very popular vegetable. This type of vegetable has some summer and some winter varieties which are grown in Bangladesh. Again, there are some varieties which can be preserved all round the year to meet up the demand of vegetables. Among the pumpkins or cucurbitaceous vegetables, sweet gourd, ash gourd and bottle gourd are main. Now we shall learn about the vegetables sweet gourd, ash gourd and bottle gourd.

a) Cultivation of sweet gourd

Introduction: Sweet gourd contains abundant amount of vitamin 'A'. This fruit can be eaten both in green and ripened stage. But its main use is in ripened stage. The leaf and young twig can also be eaten. Sweet gourd is generally divided into three groups as- Baishakhi, Barshati and Maghi.



Fig: Sweet gourd

Time of sowing: The seeds of Baishakhi sweet gourd have to be sown in Magh, of Barshati sweet gourd in Baishakh and of Maghi sweet gourd in Shrivon.

Pit preparation and fertilizer application: Generally pits having 80- 100 cubic centimeters of size have to be prepared maintaining distances between pits 3- 4 meters. In each pit, 5 kg cowdung or compost, 130 g urea, 200 g TSP, 150 g MP, 90 g gypsum and 5 g zinc fertilizers should be applied. Except urea, all fertilizers have to be mixed with soil in the pit 8- 10 days before seed sowing. Urea fertilizers have to be top dressed in two equal installments - first installment at 10 days and second installment at 35 days after seed sowing. A canal has to be made surrounding the pit and the fertilizers have to be mixed with the soil of the canal.

Seed sowing: After 10- 12 days of pit preparation, 2- 3 seeds have to be sown in the center of each pit.

Cultural operations: Soil should be lifted to the base of the seedlings after cleaning weeds if present. The base of the seedlings should be loosen frequently by nirani. Some amount of straw has to be spread near the base after 15- 20 days. Straw has to be spread beneath the fruit after starting of fruit setting. Baishakhi sweet gourd grows in soil, other sweet gourd require matcha. Some vines and leaves should be pruned if they are found excess.

Insect and disease control: Among the different insects of the circuitous plants, the remarkable ones are red fly, epilachna beetle and fruit fly. To control these insects, Sevin and Diazinon may applied. Among the diseases of this type of vegetables, , the principal ones are powdery mildew, downy mildew and anthracnose.

Crop harvesting and yield: Sweet gourd can be eaten from the young stage to fully mature stage. For that reason, crop harvesting starts from the young stage. Sweet gourd, if harvested at fully matured state, can be stored for long time. The yield per decimal area may be 80- 100 kg.

b) White gourd

Introduction: This vegetable is known as ‘Chal Kumra’ since the plant of this vegetable is lifted on the roof of hut (chal in Bengali) in the villages of the Bengal. Young fruit (jali) is used as curry and mature fruit is in preparing ‘morobba’ or ‘halua’.

Varieties of white gourd: There is no any recommended variety of ash gourd. But the variety named BARI ash gourd-1 developed by BARI is cultivated in all the regions of Bangladesh.



Fig: White gourd

Soil: This is cultivated in loamy soil. But by adopting appropriate management practices, it can be cultivated in any type of soil except clayey soil.

Time of sowing: February- May.

Valley preparation: Land should be leveled after ploughing and breaking clods by laddering. The height of valley in the land should be 15- 20 cm, width 2.5 cm having suitable length. Thus valleys have to be prepared. Between two adjacent two valleys, 60 cm wide irrigation and drainage canal have to be made. In household garden, to cultivate white gourd, the plants are lifted on the matcha, roofs of hut or on the tree after sowing seeds in valley.

Fertilizer application in the valley: In each valley, 10 kg cowdung, 200 g TSP and 50 g MP should be applied.

Pit preparation in the valley: As like as sweet gourd cultivation.

Seed sowing in the pit of valley: In each valley, 4- 5 seeds have to be sown in rows. Seeds will germinate within 5- 7 days. Some days after seedling emergence, 2-3 strong seedlings have to be kept in each valley.

Task: The learners will visit a vegetable garden nearby to the school and will submit a group- wise report on the steps involved in cultivation of white gourd and sweet gourd.

Cultural operations: Irrigation water has to be supplied if the valley becomes dry. Measures have to be taken for draining out stagnant rain water. The matcha has to be made to facilitate plant growth. Weeds on the valley have to be cleaned. Soil should be lifted on the base of the plants.

Pest management: Fruit fly, red pumpkin beetle, epilachna beetle, red mite etc, damage the fruits. These insects should be controlled by applying insecticides. Besides, powdery mildew created white powder on upper leaf surface and downey mildew created white- pink color on the lower leaf surface etc. diseases make the plants weak. Applying fungicides or bordue- mixture can save the plants from these diseases.

Cultivation of bottle gourd

Introduction: Bottle gourd is a popular vegetable in Bangladesh. Its leafy vegetable is more nutritious than bottle gourd.

Varieties of bottle gourd: There are many bottle gourd varieties found in Bangladesh. These varieties can also be distinguished based on the size and shape of the fruits and nature of vine. However, the name of some local improved and research developed varieties are cited below:

a) Local varieties: Deep green to light green.

b) BARI bottle gourd 1, BARI bottle gourd 2: Long light green.

c) Hybrid varieties: Round or long.

Soil: Bottle gourd production is good in many soils. But yield of bottle gourd is good in loamy soil. Bottle gourd can be cultivated in sandy soil by incorporating organic matter and necessary irrigation.

Time of sowing: August – November.

Soil preparation, valley preparation, fertilizer application in valley and pit preparation in valley: Same as cultivation of white gourd.

Seed sowing: In each valley, 4- 5 seeds should be sown. Within 4- 5 days, seeds will germinate.

Hedge and matcha preparation: When the plant becomes 15- 20 cm in height, bamboo twigs with kanchi should be inserted in the soil near the plant.

Cultural operations: When the seedlings become some extent larger, 2 seedlings per valley should be kept and the remaining seedlings should be uprooted. The soil has to be made friable with the help of nirani. Necessary amount of water should be applied in bottle gourd plant in each day.

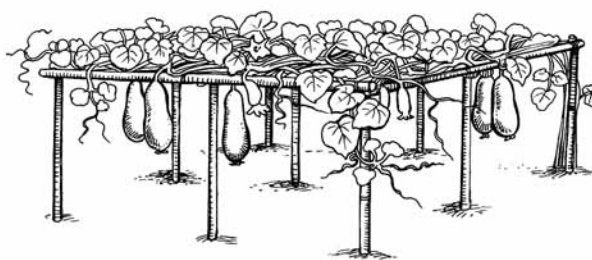


Fig : Bottle gourd

Pest management: This vegetable can be infested by red pumpkin beetle. This insect should be picked up and be killed. Besides, the mosaic virus disease may be caused by some species of grasses.

Crop harvesting: The appropriate time of fruit picking or harvesting is when-

- ☐ • ☐ when abundant awns are present on the fruit.
- ☐ • ☐ when the nail easily enters the fruit on pressure.
- ☐ • ☐ when the fruit becomes suitable for harvesting after 12- 15 days of pollination.

Yield: When BARI bottle gourd- 1 and BARI bottle gourd -2 are cultivated, 35- 45 tons per hectare ((140- 180 kg/ decimal) yield is obtained.

Cultivation of bean

Bean is a popular vegetable in Bangladesh. There is an abundant amount of protein in bean. It is a winter crop.

Soil: Loamy soil is suitable for bean cultivation. But bean can be cultivated in all types of soil by good management.

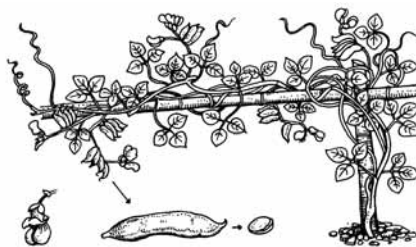


Fig : Bean plant

Varieties: BARI bean- 1, BARI bean- 2, BARI bean- 3, BARI bean- 4, IPSA bean, Ghrita kanchan, Kartika, Naldog, Baghnakha, Baromashi etc. are the popular varieties of bean.

Sowing time: The suitable time for sowing seed is mid- June to September.

Land preparation: The land should be leveled by several ploughing and breaking clods by laddering if bean is cultivated in large area. But generally bean is cultivated near house- holds, on the bank of ponds, near foot path and on the ails.

Pit preparation: The Pit having size of 45cm × 45 cm is to be prepared in the land. The distance between two adjacent pit is kept 2.5- 3.0 metre.

Fertilizer application: Each pit should be filled with compost. Then in each pit, oil cake dust, ash, TSP and MP are mixed with soil. The pit will have to be filled up so that the height of the filled valley become 10 cm. Bean crop does not necessarily require nitrogenous fertilizers. Because it is a crop belongs to leguminous family. Roots of these crops contain nodules which can fix abundant atmospheric nitrogen.

Seed sowing: In each pit, 5- 6 seeds have to be sown in 7- 8 days after fertilizer application. After seedlings emergence, keeping 2- 3 healthy and strong seedlings, all the other seedlings should be uprooted.

Cultural operations: It is necessary to make matcha for proper growth of plants. If soil of the plant base is hard, soil should be loosen by nirani. Irrigation water should be supplied if there is lack of soil moisture. The soil of plant base should be lifted towards the base to protect from water stagnancy created by rain. When the seedlings started to be larger, 60 g TSP and 60 g MP fertilizers should be top dressed at 15- 20 days interval.

Pest management: There may be infestation of aphid, thrips, pod borer etc, in bean plants. The aphids suck juice from young twigs, leaves, flowers and fruits. The extracts of neem seeds mixed with water can be sprayed to control them. The plants infected by virus have to be uprooted with soil and be put in the deep pit and covered with soil.

Crop harvesting: Based on the variety, bean fruits can be picked up from bean plants at 95- 145 days after sowing. When beans become yellow and dry, are picked up for seed purpose. The seeds are stored in clean and dry pots mixing with dust of neem leaves after separating seeds from the beans.

Yield: Yield of bean may differs based on the variety. Such as- seed yield of BARI bean- 1 is 2- 3 tons per hectare (8- 12 kg/ decimal). As vegetable, bean can be picked up throughout the year. Bean plant bears fruits in the month of Ashwin- Kartik. A bean plant can give yield more than 4 months.



Fig: Bean aphid

Task: Teacher will divide the learners in several groups and give instruction to the learners to submit a list preparing on the pests of spinach, Indian spinach, pumpkin, bean and brinjal.

Section-3

Cultivation Methods of Flowers and Fruits

Cultivation of flowers:

There is no extensive cultivation of flowers in Bangladesh. But there is small scale commercial cultivation of flowers here. Recently, commercial cultivation of tuberose, rose and gladiolus has been started. Besides, there are bela, jasmine, chamely, chrysanthemum etc. various flowers grown in Bangladesh. It is possible to be profitable by commercial cultivation of these flowers. Now we shall learn only about the cultivation of rose and bela.

Cultivation of rose

Rose is called the queen of flower. Rose is being cultivated in the many lands of Bangladesh and cultivation is increasing day by day. Rose is contributing to our economy.

Varieties: There are numerous varieties of rose throughout the world. Some of these varieties are big, some are bushy, and some are prostrate. Based on the varietal characters, rose may be of white, red, yellow, orange, pink and mixed colors. Besides, queen alizabeth (Pink), black prince (black), Irani (pink), mirinda (red), double colored flower aykkachar are cultivated.

Propagation: Based on the situation, rose can be propagated by cutting, grafting, layering and budding. To develop new variety, seedlings can be raised by producing seeds.

Land selection: Selection of land having fertile loamy soil is good for rose cultivation. In high places without shade where there is no incidence of water stagnancy, rose grows well.

Land preparation: The selected land should be made friable and leveled by 4- 5 ploughings and ladderings. Then, beds having size of 3m × 1m and 5 cm of height have to be prepared. After making beds this way, pits having size 60cm × 60 cm and 45 cm depth have to be prepared. The upper and lower surface soil of the pit should be kept separately. Before 15 days of seedling transplanting, pits should be made and kept open. In the mean time, the micro- organisms and insects die.



Fig : Rose branch with flower

Fertilizer application: Mixing the fertilizers mentioned in the table with the upper surface soil of each pit should be put in the pit. The mixing 5 kg decomposed cowdung, 5 kg decomposed leaf and 500 g ash with lower surface soil of the pit should be put on the upper surface. Thus the fertilizer is kept for 15- 20 days by filling up the pits, the fertilizers will be decomposed and be suitable for planting. The canals have to be made so that the rain water does not store at the base of the plants in rainy season.

Planting of seedlings or cuttings: The suitable time for planting seedlings is Ashwin. But if planting continues up to Poush, seedlings should be planted in the smaller pit prepared at the centre of the pit of the bed. At first after de-potting of the seedlings from the polythene bags or earthen tubs, the weak branches, diseased roots etc. have to be cut. After planting seedlings, soil has to be pressed at the base of the seedlings. The seedling should be tied to a stick after planting. It is ought to supply water at the base of the seedling after planting. It is better to take measures to provide shade for 2- 3 days.

Cultural operations

- a) **Weed control:** There are many weeds grow in the beds of rose. Weeds have to be uprooted.
- b) **Irrigation:** Considering the soil moisture, irrigation should be provided such way that there is no moisture deficit in soil.
- c) **Drainage:** It is not ought to allow water stagnancy in the beds of rose. Because rose plants cannot tolerate water stagnancy.
- d) **Pruning:** The new branch of rose bears larger numbers of flower. For that reason, it is necessary to prune old and diseased branches. If rose plants are pruned each year, structure of the plants becomes nice and strong, and blooms a large numbers of large sized flower.
- e) **Disbudding:** Some times after pruning, there grow a large numbers of leaf buds and flower buds. If all the buds are allowed to bloom, the flower size becomes not so large. For that reason, to allow blooming large sized flower, the side flower buds have to be cut with a sharp knife keeping the middle original flower bud.

Task: Teachers will visit a flower garden near to the school and will show the different types of flowers. After visiting the garden, learners will present the steps involved in rose cultivation by making poster in groups.

Management of insects and mites:

- a) **Red scale:** This insect looks almost like dead skin. The infestation of this insect is higher at hot in the rainy season. This insect sucks juice from the bark of the plants. Consequently, small black spots are found the bark. If there is no control measure for this, infested plants die. By brushing the infested area with brush, if the number of plants is low, this insect can be controlled. This insect can be controlled by applying Malathion or Diazinon.
- b) **Beetle insects:** The infestation of this insect is found in winter. This insect bores and eats the young leaves and sepals of flowers. Generally, this insect infests at night. This insect can be controlled by light trap. This insect can be controlled by broadcasting Malathion or Dimecron.

Disease management: Rose plants are infested by many diseases. Among these, black spot disease, die- back and powdery mildew are the main.

- a) **Black spot disease:** It is a fungal disease. The black round spots are found on the leaves of the infested plants. The leaves on the infested plants fall down and the plants become leafless. The infestation of this disease occurs in the month from Chaitra to Kartik. To control this disease, the balanced fertilizers have to be applied. Care has to be taken not stagnant water at the base of the plants. Beside, this disease can be controlled by applying fungicides. The infested leaves should be cut and burnt.
- b) **Die- back:** The cut end of the plants after pruning is infested by this disease. On infestation of this disease, the branch or stem are being started to die by becoming black in color from the top to the bottom. This symptom gradually reaches to the roots through the stem and the entire plant die. To control this disease, the infested branch or stem should be cut at the considerable below the infested part and be burnt. The branches should be pruned by wiping the knife used for pruning with antiseptic. The cut end has to be wiped with spirit.
- c) **Powdery mildew:** It is a fungal disease. This disease is dispersed in winter during fog. The white powder is found on leaf, young flower and bud if infested by this disease. Consequently bud becomes damaged without blooming. To control this disease, the infested twig or leaf has to be plucked and burnt. Beside, Thiovit or Sulphur Dithane M- 45 mixing with water and spraying once per week can be controlled this disease.

Plucking of flower: Before blooming flowers, they should be plucked from the plants. After collecting, deeping the lower portion of petiole in water and keeping them under shade they can be kept well. It is better to spray water on flowers occasionally.

Cultivation of jasmine

The flower turf and flower band are used in most of the occasion in Bangladesh. There is popularity of jasmine as aromatic flower here. Jasmine is used in different festivals and occasions. It is a cash flower.

Varieties: Three types jasmine varieties are found. These are: 1. Single type and highly aromatic 2. Medium sized and double type 3. Large sized and double type.

Propagation: Jasmine flower can be propagated by layering, grafting and cutting. To develop new variety, seedlings can be raised by producing seeds.



Fig: Jasmine plant with flower



Fig: Layering in tub

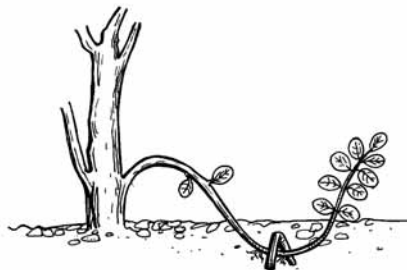


Fig: Layering in soil

Ploughing and fertilizer application:

Jasmine flower can be cultivated in all types of soil except sandy soil and heavy clayey soil. It is better to have facilities for irrigation and drainage. The land has to be made friable and leveled by 4- 5 ploughing and laddering. The organic fertilizers, urea, phosphate and MP fertilizers have to be applied during land preparation. The seedlings should be planted at 1 metre intervals. Irrigation water should be supplied applying urea after planting seedlings.

Preparation of cutting or seedling: The cuttings or seedlings of jasmine flower can be prepared from last of summer to last of rainy season. The distance between seedlings and between lines should be 50 cm. For planting seedlings, pits should be prepared and the soil lifted from the pits should be sun dried. The pits should be filled by that soil mixing with organic fertilizers and wood ash. Thereafter, the cuttings of jasmine flower should be placed in each pit. It is better to place cuttings in rainy season or later part of the rainy season. But if there is good facilities for irrigation, cuttings can be prepared in spring.

Planting of seedlings in tub: Jasmine can be cultivated in tub by mixing appropriate amount of urea, TSP and MP with loamy soil having organic matter. The tubs can be kept on the corridor or on the roofs.

Cultural practices

- a) **Irrigation:** It is necessary to have soil moisture all time for cultivating jasmine flower. It is necessary to irrigate 10- 12 days intervals in summer, at 15- 20 days intervals in winter and 2- 3 irrigations in rainy season based on the condition of the land if there no timely rainfall.
- b) **Weed control:** The weeds should be cleaned regularly from the land or tub. If straw pieces are spread on the land, requires lower irrigation and weeds cannot grow abundantly.
- c) **Pruning:** It necessary to prune branches of jasmine plants each year. It is ought to prune branches in the middle of winter. The jasmine plant should be pruned at the 30 cm above the ground level. Fertilizers should be applied in the land or tub some days after pruning.

Pest management:

The harmful insects are rarely found in jasmine plants. But mites may attack. Because of their attack, white layer is formed on the leaves, the infested leaves become curl and round. Sulphur miticides such as- spraying saltaf, calthane etc. on leaves, the mites can be controlled.

A yellow mottle spotted fungus is found on the leaves of jasmine flower. This disease can be controlled by applying Agrosan or Trasel- 2.

Yield: The flowers bloom in the jasmine plants from the month of February to July. Yield increases year to year. The yield in the vine type jasmines is more. Generally, after 5- 6 years, the older plants are cut and new seedlings are planted.

Task : The learners will submit a report preparing on " It is possible to get economic benefit by solving unemployment problem through cultivating rose and jasmine flowers".

Cultivation of fruits:

There are various types of fruits grown in Bangladesh. The soil and weather of this country is very suitable for cultivation of fruits. We shall learn about the cultivation of banana and pineapple.

Cultivation of banana

Banana grows more or less in all the districts of Bangladesh. But banana is extensively cultivated in Narsindi, Munsighanj, Bogra, Jessore, Barisal, Rangpur and Mymensingh districts. Banana is cultivated in about 40 thousand hectare of land from which more than six lac tons banana is produced. Banana is rich in vitamins and minerals. The calorie content in banana is also higher compared to other crops. Banana is cultivated almost all over the country in Bangladesh. Banana is consumed as curry at green stage and as fruit at ripened stage. There is a great demand of banana as a diet of patient.

Variety of banana: The varieties of banana which are commercially cultivated in Bangladesh are Amritsagar, sabri, champa, mehersagar, kabri etc. But three improved varieties named BARI banana- 01, BARI banana- 2 and BARI banana- 3 have been released. Among these, The variety BARI banana- 2 is used as green banana.

Production technology of banana: Production technologies of banana include soil and land preparation, time of planting and seedling planting, methods of fertilizer application, intercultural operations etc.

Soil and land preparation:

1. Fertile loamy soil is suitable for banana cultivation.
2. The land should receive sufficient sun light and have drainage facilities.
3. The land should be deeply ploughed and thereafter pits measuring 50 cm× 50 cm× 50 cm should be made maintaining 2 m distance between pits.
4. About one month before planting of seedlings, pits should be made and filled with soil along with cowdung, TSP fertilizers.

Time of seedling planting: In three seasons in a year, banana is cultivated and banana seedlings are transplanted. Such as:

1. Ashwin- Kartik 2. Magh- Falgun 3. Chaitra- Baishakh

Selection of banana seedlings: banana seedlings are called suckers.

Two types of suckers are found. Such as:

1. Sword sucker
2. Water sucker

Sword sucker: Sword sucker is the most suitable for banana cultivation. The leaves of sword suckers are narrow, pointed and looks almost like a sword. It is wider at the base and gradually narrower at the tips.

Water sucker: Water sucker is weak. The base and tip of this sucker is similar in width. This seedling is not suitable for banana cultivation. Besides these two types of seedlings, it is possible to propagate banana from the whole rhizome or from its small portion. But it requires more time to bear fruits. The rhizomes both from fruit bearing and non- bearing plants can be used as seedlings.



Fig: Banana plant

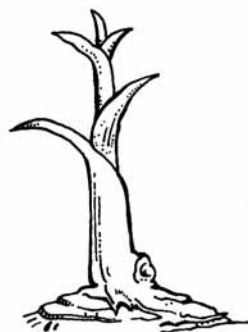


Fig: Sword sucker



Fig: Water sucker



Fig: Rhizome

Planting of seedlings: 1. At first sword suckers should be selected for planting seedlings.

2. For dwarf variety, 35- 45 cm and for tall variety, 50- 60 cm sword suckers are used.
3. Thereafter, the seedling should be planted in the specific pit which is filled with cowdung and TSP. Care should be taken not the stem be inserted in to the soil.

Methods of fertilizer application: In banana plant, cowdung/ compost, TSP, Mp and urea fertilizers are used. The name of fertilizers, dose per plant and time of application are cited below:

Name of fertilizers	Amount per plant	Time of application
Urea	500- 650 gm	One month before planting of seedlings, should be mixed with soil and be filled up the pit. One month before planting, 50% TSP should be mixed with soil and be filled up the pit. Two months after planting, 50% MP and 50% TSP should be spreaded around the base of the plant and thereafter be mixed with soil. When the plant age becomes two months, 25% urea should be spreaded around the plant base and mixed with soil along with MP and TSP. After another two months, 50% MP and 50% urea should be applied around the plant base and be mixed. The rest 25% urea should be spreaded around the plant base at flowering and mixed with soil.
TSP	250- 400 gm	
MP	250- 300 gm	
Cowdung/ Compost	15- 20 kg	

Cultural operations

Irrigation and drainage: 1. Measures are to be taken to irrigate banana field if there is no soil moisture. It is necessary to irrigate at 15- 20 days interval during dry season.

2. The necessary drainage channel should be made to drain out excess water in rainy season. Because the banana plants cannot tolerate submergence.

Cutting excess seedlings: 1. The suckers that are grown in the plant base up to flowering, should be cut.

2. It is better to keep one sucker per plant after flowering.

Propping: After appearing bunch in banana plant, the plant can be broken by air flow. In that case, tying banana plant with the bamboo stick or branch of plant can protect the bunch from breakage.

Management of insects and mites: The banana plant may be attacked by fruit and leaf beetle, rhizome weevil, thrips. This insect can be controlled by spraying Diazinon 60 EC mixing with water.

Disease management: Mainly three diseases infest the banana plant during cultivation. These are- 1. Panama disease 2. Cigatoga disease 3. Bunchy top disease.

1. Panama disease: It is a fungal disease.

Due to the infestation of this disease, leaves become yellow. The leaf is broken at the petiole base thereby become lodge and sometimes the stem is cracked. The infested plant gradually dies or does not bear flower and fruit. As a preventive measure, disease free seedlings should be planted, the infested plant should be uprooted and disease resistant variety should be planted. Beside, applying a fungicide named Tilt- 250 EC at recommended dose on the infested plant effective result may be got.

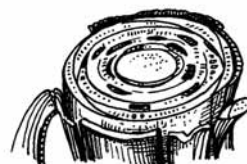


Fig : Plant infested with panama disease



Fig: Plant infested with cigatoga disease

2. Cigatoga: It is a fungal disease. Due the infestation of this disease, round or oval deep brown spots are found on the leaves. If infestation is extensive, the leaf becomes blighted and the whole leaf looks like burnt. Consequently the fruits become smaller and yield is reduced. As a control measure, the leaves of the infested plants should be cut and burnt.

3. Bunchy top: It is a viral disease. This disease is dispersed by aphid. By controlling aphids applying Malathion or other recommended insecticides, banana plant can be escaped from this disease.



Fig: Plant infested with bunchy top

Task: The learners will prepare and submit a report on the name, causes, symptoms and the control measures of various diseases of banana.

Crop harvesting:

1. After 1- 15 months of planting seedlings, all varieties of banana becomes suitable for harvesting.
2. The bunch of banana is cut with a sharp hashua.

Yield: If cultivation is proper, banana yields 20 kg per plant or 20- 40 tons per hectare would be produced.

Cultivation of pineapple

In Bangladesh, nearly in 14 thousand hectares of land, banana is cultivated. Banana is cultivated extensively in Sylhet, Moulvibazar, Chittagong, Chittagong hill tracts and Madhupur of Tangail. A large amount of pineapple is also grown in the districts of Dhaka, Narshindi, Comilla, Dinajpur. But since it is used in various types of processed food (Juice, jam, jelly etc.), pineapple has a special importance all over the world. Pineapple is also an important fruit in the international market as a commercial fruit. Now it is a cash crop in Bangladesh. Pineapple plays a special role in the international market as an export enterprise.

Varieties of pineapple: There are three varieties found in Bangladesh. Such as- Haniqueen, Giant kew and Ghorashal.

Production technologies of pineapple: The technologies are discussed below:

Soil and land preparation:

1. Sandy or sandy- loam soil is suitable for pineapple cultivation.
2. The ploughing and laddering should be made such a way that the soil becomes friable and level and cannot stagnant rain water.
3. For planting seedlings, beds, each measuring 15 cm in height and 1 m in width should be made. The distance between two beds should be 50- 100 cm.
4. For cultivating pineapple in filly slope, the selected land should be such that its slope is not much higher.
5. The soil of the hilly slope should not lose by ploughing or spading, it should be made suitable for planting seedlings only by weeding.

Seedling selection and land preparation: The propagation of pineapple is caused by only vegetative means. Generally four types of seedlings are produced in pineapple plants which are called suckers. The descriptions of the suckers are given below:

1. There are two types of seedlings produced on the upper end of the fruit. The seedling that produced straight on the upper end of the fruit is called crown seedling. The seedling originates from the base of the crown seedling is called crown slip.
2. The seedling that are produced from the base of the fruit is called root sucker.
3. The seedling that originates from below the base of the fruit but from the above ground stem is called stem sucker.
4. The seedling that originates from the under- ground stem is called stamp. Stamp and stem sucker are the most suitable for pineapple cultivation.

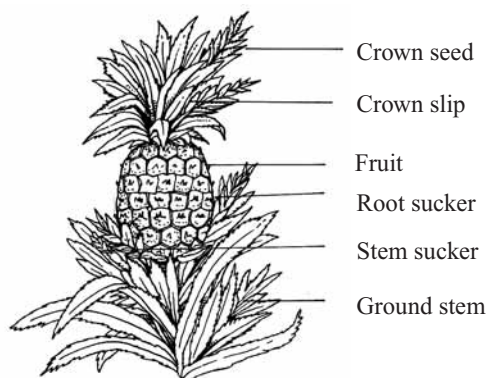


Fig : Different types of pineapple seedlings

Planting of seedlings: 1. The appropriate time for planting pineapple seedlings is mid Ashwin to mid Aghrayan.

2. The time of planting seedlings can be delayed for one or one and half month if there is irrigation facilities.
3. The seedlings have to be planted maintaining distance between lines 40 cm and between seedlings 30- 40 cm.

Methods of fertilizer application: 1. The first step of fertilizer application method is to determine the amount of fertilizer. For pineapple, per plant fertilizers have to be applied as the following doses:

Name of fertilizers	Amount of fertilizers per plant (gm)
Decomposed cowdung	290-310
Urea	30-36
TSP	10-15
MP	25-35
Gypsum	10-15

2. (a) The cowdung, TSP and gypsum should be mixed with soil during bed preparation.
- (b) Urea and MP should be applied in 5 splits when the seedlings become 4- 5 month old. Fertilizers should be mixed well with soil.

Intercultural operations: 1. Measures are to be taken to irrigate in dry season. 2. The canals are to be made to drain out excess water in rainy season. 3. If the seedlings become very long, keeping 30 cm top leaves should be cut. 4. The pineapple land should be kept weed free. 5. Pineapple field is not affected by so harmful insects and diseases. For that reason, pest management is not discussed.

Fruit collection: 1. From Magh to Chaitra month, when seedling become of 15/16 months old, inflorescence of pineapple starts to come out.

2. From Jaistha to Vadro, pineapple ripens.

3. Fruit should be collected by cutting stalk from the bush.

Yield: Honey queen yields 20-25 tons and Giant kew yields 30-40 tons per hectare.

Task: Teacher will show various fruit trees to learners taking them to a fruit garden nearer to school. After visit fruit garden, learners will collectively write the steps of cultivation method of pineapple in poster and represent in the class.

Section-4

Method of Fish Culture

A lot of shing, magur, pabda, and tengra were available in different natural water body in our country like canal-beel, haor-baor, ditch-drain etc. These fishes are scale less catfish type. The fishes which are included in siluriformes order, do not have scale in the body but have antenna like cat and they are called cat fish. Presently availability of fish has been much decreased due to natural disaster of aquatic environment and excessively catching fish. The requirement can be met up by fish culture. Method of shing and magur culture is almost same. Besides, there is much similarity between the culture method of tengra and pabda. Few types of tengra fishes are available in Bangladesh. Among them, the method of gulsha and tengra fries culture has been invented. The method of shing, magur, pabda and gulsha culture are described below:

A) Method of shing and magur fish culture

Introduction of shing and magur fish:

There is slight resemblance of body characteristic between shing and magur fish. Their body is long, ventral side cylindrical, dorsal side flattened and scale less, upper and lower side of head is flattened. Four pairs antenna in head, and one pair spines are present in both sides of head. But shing fish is smaller than magur fish in size and head is comparatively thin. Spines of both sides are toxic in shing fish and that's why if stung by spine of shing fish, much pain is felt in affected area. The colour of shing fish is brownish red in younger stage and grayish black in adult stage. On the other hand, the colour of magur fish is dark brown in younger stage and grayish brown in adult stage. A special characteristic of shing and magur is that they have an extra respiratory system except gill and by which they can receive oxygen directly from air. So, they can survive long time in water with less oxygen and even in without water. That's why shing and magur fish are called geol fish. Shing and magur fish belong to omnivorous. They stay at bottom of the water body and eat aquatic animals and decomposed organic wastes. They breed one time a year and their breeding season is May to September. But highest breeding is obtained at June-July.



Fig: Shing fish

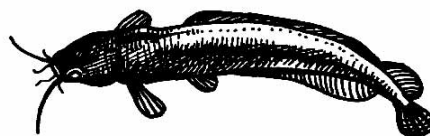


Fig: Magur fish

Advantages of culture of shing and magur fish

1. There are more demand of shing and magur in the market and that's why more profit can be obtained by their culture.
2. Method of culture is easy. They can be cultured in any types of water body even in water reservoir and cage.
3. They can survive in adverse environment such as less oxygen, high temperature of water, even in polluted water.
4. They can be cultured in less water and with more density.
5. Less affected by disease and high tolerant.
6. They can be marketed as live condition as they can survive in less water and even in without water.
7. If caring properly, fishes can be marketed early (6-8 months).
8. Along with individual culture, they can also be cultured with carp fish, tilapia fish etc as mixed culture.

Nutritional importance of shing and magur:

Nutritional value of shing and magur is more than that of many large species of fish. They have much quantity of iron suitable for body. They contain more protein and low fat. So, these are easily digestible. These fishes are more popular as diet for rapid development of health at and after the time of sickness. Shing and magur fish help to prevent anaemia and to increase body energy.

Selection and preparation of pond for culture:

The pond should be 1-1.5 metre deep for culturing of shing and magur. It should be better if the pond area is 10 to 30 decimal. If the bank of the selected pond is damaged, it has to be repaired before culture. Water hyacinth with other aquatic weeds of the pond should be removed out. Big trees should not be available on the bank of the pond. Predator and unnecessary fishes in pond should be removed out. This can be done by drying pond, repeatedly netting or rotenon applied in the pond water. It is better to prepare pond by drying it at winter when the pond contains less water. After drying pond, lime, cow dung or poultry faeces, urea, TSP fertilizer should be applied properly at required level per decimal. If water remains in the pond, lime and fertilizer have to be applied in the water.

Making fence by net

During preparation of pond for culturing shing and magur, it is an important work to make a fence or net with 30 cm height around the pond. The advantage of fence is that fish cannot go outside of the pond during rainfall. Specially, magur fish often go outside of the pond by their body stretching during slight rainfall or flood. On the other hand, enemies of fishes like snakes, frogs cannot enter into the pond due to making fence. All around the bank of the pond should be protected by placing nylon net with the help of poles. Lower part of the net should be attached with soil by inserting them slightly into the soil so that no gap remains between the net and soil. This work should be performed immediately after drying the pond. Because, harmful animals like frogs, snakes are not available in pond at dried condition. The animals remain in the pond when it contains water and they are arrested if making fence. In that case, action is to be taken for killing them into the pond by koach or bait.

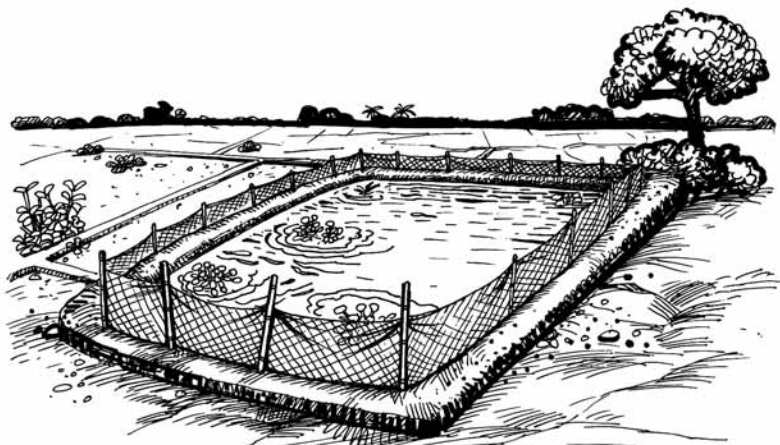


Fig: Fence of net in the pond of magur fish

Fry stocking

150-200 fries of magur fish should be stocked for per decimal after 5-7 days of pond preparation. As the shing fish is smaller in size, more fries like 300-400 can be stocked. 3-4 silver carp fishes can be released in the pond so that they can eat excessively producing phytoplankton and keep environment good. If the water can be altered, 250-300 magur fries and 400-450 shing fries can be stocked per decimal. If culturing shing/magur with carp or rui fish as mixed culture, 50 shing/magur fries and 40 rui fries can be stocked per decimal. Standard time for releasing fish is morning or afternoon (cool weather). Fries cannot be stocked at sunny noon or cloudy day. Before releasing fry in the pond, they should be purified with potash or salt mixed water and adjusted with pond water. You have already known detailed about this matter in the agricultural ingredients part, chapter 2.

Subsequent management of stocking

1. Feeding management

Supplementary feed should be provided to shing and magur. Variuos feed ingredients for making supplementary feed and their mixing rate are given below-

Ingredients for supplementary feed for shing and magur and their mixing rate

Feed ingredients	Mixing rate (%)	
	Sample-1	Sample-2
Fish meal	20	20
Meat and bone meal	25	
Sesame oil cake	10	20
Rice polish	25	30
Wheat bran	15	12
Flour/molasses	4	5
Vitamin mineral premix	1	1 gm/kg
Soybean meal	-	8
Broken corn	-	5

Level of feed supply for shing/magur according to their body weight is given below-

Average weight of fish (gm)	Daily feed requirement (%)
1-3	15-20
4-10	12-15
11-50	8-10
51-100	5-7
>101	3-5

Feed supply method: Daily feed has to be divided into two groups and supplied in two times (morning and afternoon). Small balls should be made by mixing feed with slight water and provided on the tray placing under the water in some specific places of the pond. Mustard oil cake should be soaked in water 24 hours before feed preparation. Commercial feed from market can also be provided to fish. The price of this feed is higher than home made feed.

2. Health management

Fish should be checked frequently by netting whether they grow regularly or not and affected with diseases or not. Generally, no disease is found in shing and magur. But sometimes, ulcer, tail and fin rot and edema found in winter. Their management system is given below:

Ulcer: The disease is mainly caused by a fungus named *aphanomyces invadans*. It causes ulcer in muscle. If 1kg lime and 1kg salt per decimal applied in water with 1-1.5 meter deep in pond, affected fish may be recovered within two weeks. If provided lime and salt at the same level in early winter as advance prevention management, fish can be kept free from diseases in winter.

Tail and fin rot: The disease is caused by aeromonads and myxobacter types bacteria. Affected fish should be washed out for 3-5 minutes with water mixing with potassium permanganate at 5 mg/litre of water. Fertilizer apply in the pond should be stopped. 1 kg lime per decimal can be applied in the pond.

Edema: It is a bacterial disease. It causes swelling to belly. Fish moves imbalanced way and finally die. Water is removed out by an empty syringe from the belly of affected fish. Mixing of 200mg chloramphenicol powder with 1 kg feed should be supplied. 1 kg lime per decimal can be applied in affected pond.

Fish collection

If rearing properly, shing and magur fish may be suitable for marketing after 7-10 months. In that time, average body weight of shing and magur are 100-125g and 120-140g, respectively. Most of the fishes are to be caught out by netting. Pond should be dried out to collect all fishes.

Task: Learners will approximately estimate the production and income-expenditure of a pond for culturing shing and magur fish and submit it by writing in a notebook after analysis.

B) Method of pabda and gulsha fish culture

Introduction of pabda and gulsha

Pabda and gulsha fishes are available in beel, haor, river, pond and lake. These fishes are very tasty. That's why; demand and market price of the fishes are comparatively high. Pabda fish is 15-30 cm long, flattened body and back side gradually thinner than front side. Mouth is very wide and curved. Lower jaw is wider than upper jaw and two pair long barbs are present in the front side of mouth. Dorsal fin is small, anal fin is very long and tail is divided into two parts. Colour of upper level (dorsal) is grayish silver where as belly side (ventral) is white. Black spots are found in the back of the operculum nearer to the neck. A yellowish stripe may be found on the lining of backbone. Pabda fish breeds from May to August. Maximum breeding can be carried out at June-July.

Gulsha fish is 15-23 cm long and body flattened from side. Dorsal side is curved, mouth is small, upper jaw is slightly enlarged. 4 pair barbs are present in mouth. Dorsal and operculum fin are with long spine. Coat colour is olive grey, lower part is slightly light. A bluish stripe is found on the lining of backbone. They lay once a year. Breeding season of gulsha fish is from June to September. Maximum breeding can be carried out at July-August.

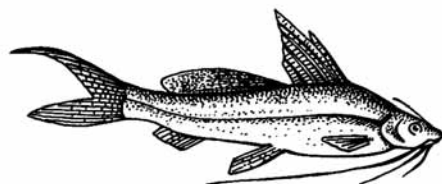


Fig: Gulsha

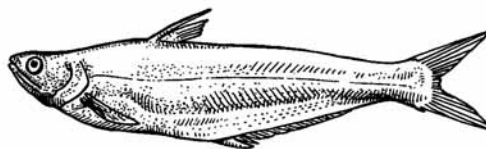


Fig: Pabda

Importance of pabda and gulsha culture:

1. High demand in the market and price is comparatively higher than other fishes. So, it is possible to increase income of rural people by the culture of these fishes.
2. Much quantity of various protein and micronutrients are available in their body.
3. Very tasty to eat.
4. Method of culture is easy.
5. Fries can be produced by artificial breeding, so, they can be easily available.
6. They can be cultured not only in annual pond but also in seasonal pond as well as in shallow water body.
7. They grow rapidly and that's why they can be marketed at 5-6 months.

Selection of pond for culture:

Generally, these two types fishes can be cultured in pond of 15-20 decimal area where water remains for 7-8 months. The depth of the pond should be 1-1.5 metre.

Pond preparation

The bank of the pond should be repaired and the aquatic weeds should be cleaned out. No big trees should be available in the bank of pond. If remain, scrapping them so that no tree leaves and shady fall on to the pond. Predator and unnecessary fishes are removed out from the pond. After that, lime should be applied in the pond at the rate of 1 kg per decimal. After 5-7 days of applying lime in the pond, 6-8 kg cow dung, 100g urea and TSP 50g should be applied per decimal.

Fry stocking

After 3-4 days of applying fertilizer, fries with 3-4g weight can be stocking at the rate of 250 fries per decimal. Fries should be released in the pond at morning or afternoon; or at cool weather of the day. Fries should not be released directly in the pond just after taking. Before releasing fries in the pond, water is to be purified by potash or salt and fries are to be adjusted with pond water.

Task: Learners collectively make an estimate of income-expenditure for culture of pabda and gulash and submit in the class.

Feed ingredients	Mixing rate (%)	Feed apply method
Fish meal	30	Feed should be supplied on the tray placing into the water at the rate of 5-6% of the body weight daily two times (morning and afternoon).
Meat and bone meal	10	
Mustard oil cake	15	
Soybean oil cake	20	
Rice polish	20	
Flour	4	
Vitamin mineral premix	1	

Feed supply

Ingredients for preparing supplementary feed of pabda and tengra fish and their mixing rate

Application of fertilizer

For making natural feed along with supplementary feed, 4-5 kg decomposed cow dung per decimal can be supplied in liquid condition in a sunny day after every 7-15 days.

Management:

Care should be taken whether fish can take feed regularly or not. Before giving feed on tray, it should be checked whether fish took previous day's feed completely or not. Amount of providing less feed should be the equal amount of leftover feed. Amount of feed should be fixed by evaluating body growth of fishes collected by netting twice a month. Horra can be pulled in the pond once a week. Water will be added from outside if the water level is less in the pond. If water transparency remains within 25 cm (secchi disk depth), application of fertilizer can be stopped.

Fish collection

Gulsha fish becomes 40-45g weight at 6 months and pabda fish 30-35g weight at 7-8 months of age. This size of pabda fish can be collected by seine net and on the other hand, gulsha can be collected by drying the pond.

New words: Geol fish, Aphanomyces invadans, Micronutrients

Economic importance of fish culture:

Importance of fish culture is unlimited in fulfilling our nutritional requirement, creating employment opportunities, earning foreign currency and social development. Economic importance of fish culture is described below.

1. Fulfilling nutritional requirement: Main source of protein of our daily food menu is fish. It is a delicious and nutritious food. It supplies protein about 60% of our daily food. An adult person needs daily 80g protein rich feed. But, presently, we can take only 21g in average. It is possible to meet up protein requirement by fish culture. So, fish culture is very important.

Besides, fish oil is good for health. Various types of small fishes like mola, dhela, kachki contain more vitamin A. Vitamin A prevents night blindness. Enough calcium and phosphorous are available in fish that can help to build up our bones.

2. Creating employment opportunity: About 10.50% or 15.6 million people of Bangladesh maintain their livelihood by various ways from fisheries sector, such as fish culture, fishing, selling etc. In our country, employment opportunity is decreasing due to increasing population. Employment opportunity can be created by fish culture.

3. Increasing exporting income: Bangladesh earns enough foreign currency by exporting fish abroad. 2.73% of total exporting income is obtained from fisheries sector. This earning can be further increased by fish culture.

4. Socio-economic development: There are many fallow lands, ditches and drains available in Bangladesh where fishes are not cultured. The socio-economic condition of poor and low income people can be developed by culturing fish in those water bodies.

Section-5

Method of Integrated Fish Culturing

Concept of integrated culturing

Traditionally, chicken-duck, cattle-goat are reared in about every house of villages in Bangladesh. Moreover, many houses have pond that can be used for some household works like washing, cooking, bathing etc. Fishes are also cultured in these ponds by old method. Chicken-duck, fish can play role for fulfilling household feed requirement. If rearing chicken-duck in the house making on the pond, no extra space is required for them. On the other hand, cow dung and poultry faeces can be used as fertilizer in the pond. Additionally, if throwing leftover feed of poultry in the pond, it may be used as supplementary feed for fish. Fruits and vegetables can also be cultivated on the bank of the unused pond where excess mud (decomposed organic matter) in the bottom layer of the pond can be used as fertilizer. On the other hand, shedding leaves of fruits and vegetables can be used in the pond as compost fertilizer. Moreover, it is possible to cultivate fish along with rice in the rice cultivating land during the time when water remain in the land for few months. In this case, fish faeces help to increase fertility of land. The fishes intake the harmful insects and inhibit to grow weeds in the fish culturing land. Thus, when several crops are cultivated in the same time and in the same land called integrated cultivation. In integrated cultivation, when other crops are cultivated with the fish, called integrated fish culturing.

Importance of integrated culture

1. At a time several crops are obtained from same land with low cost. That's why excess feed is produced.
2. One crop works as supportive to other.
3. Environmental balance is maintained.
4. Low cost in fertilizer use.
5. Labour can be utilized properly (labour given for producing one crop, equal labour can be used to produce several crops.).
6. Ensuring the best utilization of wealth and prevent wastage.
7. Less risk, therefore, if hampering production of one crop, loss can be almost recovered by another production.

We will know about two important integrated fish culture method (Integrated fish-duck/chicken culture and fish & prawn culture in rice field) which is given below.

A) Integrated fish and duck/chicken culture**Advantages of integrated culture of fish and chicken-duck**

1. Chicken or duck's house is built up on to the pond and that's why, no separate space is required. 2. Faeces of chicken or duck directly falls down into the pond which is used as organic fertilizer suitable for fish culture. Thus, no additional fertilizer should be applied into the pond from outside. 3. Leftover feed of chicken or duck directly falls down into the pond which is used as feed for fish and that's why no separate supplementary feed need to be supplied for fish. 4. Duck keeps environment good by taking insects and mature tadpole (young frog). 5. Duck swims in the pond, in this way, oxygen of air can be dissolved with pond water and that's why, no oxygen lacking in pond water. 6. As fishes, meat and eggs are found from one place, so, more feed production and best utilization of wealth is ensured.



Fig: Integrated fish and duck culture



Fig: Integrated fish and chicken culture

Pond selection and preparation: Very small pond is not suitable for culturing integrated fish and duck/chicken. Pond area should be at least 33 decimal. The pond which contains water remaining for at least 8-10 months a year with 1.2 to 1.8 meter (4-6 feet) height should be selected. After that, pond should be prepared for fish culture by proper method. But no fertilizer should be applied during pond preparation for integrated chicken-duck and fish culture. Duck/chicken chicks should be received in the house making on to the pond after 7 days of applying lime. After 7-10 days of receiving chicks, fries should be released in the pond.

Making house for chicken-duck: To reduce the cost, single or double roofed house can be made by using locally available bamboo, wood and straw. The house should be onto the pond water and 1.2 to 1.5 metre (4-5 feet) from bank of the pond so that faeces and leftover feed of chicken/duck may not be fell in the soil even reducing water level in dry season. The distance between water upper level of pond to floor level of house should be 0.46-0.6 metre (1.5- 2.0 feet) and floor to roof of the house should be 1.2-1.5 meter (4-5 feet). For passing enough light and air into the house, space between roof and side wall should be protected by net. Floor of the house can be made by bamboo slips. Distance between one slip to another slip of bamboo should be 1 cm so that faeces and leftover feed can be directly fell down into the pond but causes no injury by inserting chicken leg into the gap between slips. Chicken/duck house can also be made on the bank of the pond.

Determination of number and breed of chicken/duck: 2 improved breeds of chicken (broiler or layer) or duck can be reared in each decimal of the pond.

Chicken-duck feed: At early stage, each duck should be provided daily 60-90g balanced feed up to 90 days and subsequently provided 110-125g balanced feed. Required amount of water should be mixed up during feeding duck. Regular feed supply for broiler chicken as required amount should be ensured. Each layer chicken should be provided daily 80-90g feed up to 4 weeks and subsequently provided daily 110-120g feed. Separate equipment should be used for taking feed and water.

Disease control of chicken-duck: Chicken/duck may be affected by disease. Advice should be taken from nearer veterinary doctor if any disease is found. For disease prevention, the chicken-duck house should always be kept in dry place. Regular keep floor of the house and feeder & drinker should be cleaned regularly. Vaccination and injection should be provided according to doctor's advice. Sick chicken/duck should be separated from healthy ones as early as possible.

Selection of fish species and stocking density: Various carp type fries with 8-12 cm can be released 35-40 per decimal in the pond by the following ratio, among them per decimal 4 katla/big head, 9 silver carp, 8 rui, 4 mrigel and carpio each, 1 grass carp and 5-10 shwarpunti should be released.

Grass carp is fed on grass. So, grass grown in the bank of pond, soft leaves, banana tree leaves etc have to be provided. No feed should be supplied to the other breeds of fish from outside. They can take feed falling from chicken/duck as leftover.

Post stocking caring of fish: Fish health should be checked every month by netting. If lacking oxygen in the pond, it should be managed by altering pond water, bamboo beating or swimming. If excessive gas storage in bottom of the pond, it can be removed out by pulling horra. To protect from ulcer disease, 1 kg lime should be applied at the beginning winter.

Production: If integrated fish cum chicken/duck culture is done by good management, 18-21 kg fish can be produced without applying fertilizer or feed in the pond. The breed of khaki campbell and Indian runner duck lay 250-300 eggs per year. A broiler chicken becomes 1.5-2.0 kg at 2 months of age and layer chicken lays 200-250 eggs.

B) Fish and shrimp culture in rice field

For rice cultivation, lands require to keep water for long time. If this rice fields are made by well planed, several cultivation of rice, fish & shrimp can possible be obtained within a year. According to specialist's opinion, presently 2.0 lakhs hectare lands in Bangladesh are especially suitable for culturing fish and shrimps in rice field which can be used now. Another 3 lakhs hectre rice field can be used for culturing shrimps and fish in future.

Advantages of fish and shrimp culture in rice field: 1) Fish and shrimp can be produced as extra culture in the same land. In this way, land is utilized best. 2) Fish intake harmful insects of rice. So, no insecticides need to be applied in rice field. 3) Growth of weeds is inhibited due to movement of fish and shrimp. 4) Faeces of fish and shrimp help to increase land fertility and that's why cost of fertilizer is comparatively less. 5) Research showed that average yield of rice is increased 15% in this method.

Land selection: The land which can keep water for at least 4-6 months and the water remain with at least 12-15 cm height in aal area of the rice field during culturing, it is possible to culture rice, fish and shrimp in this land. The land which is high, therefore, cannot keep water, on the other hand, the land which is very low, therefore, easily flooded over- neither of these is suitable for culture.

Preparation of rice field for fish and shrimp culture

1. Making/repairing of ail of land: Ail of land should be prepared or repaired with hard and strong. It should be better to make ail with 30-60cm higher than water level at natural flooding. Ail should be enough wide. Thus, ail will not be broken early and some vegetables can be cultivated in ail.

2. Digging of ditch and canal/drain in rice field: For sheltering and easy movement of fish and shrimp, canal should be dug at the inner side of the ail through all around or at one or two sides of the ail. Besides, ditch can be dug at the middle or corner of the rice field. In some cases, both canal and ditch are dug in field. In that case, there is a connection between ditch and canal. 15% area of the total land should be used for ditch and canal. The depth of this ditch and canal should be 0.5-0.8 meter. Ditch is made at the lower part of land.

Advantages of making ditch and canal in rice field are- (1) If water level is down or water is warm in rice field, fish and shrimp can take shelter in deeper cool water place of ditch and canal. (2) If it is necessary to remove weed or to fish, it can be easily done by allowing fish to come into ditch or canal after drying field.

Making shelter for shrimp: Shelter for shrimp should be made with artificial plastic or dried bamboo twig in ditch or canal. Shrimp can take shelter here as sensitive condition during molting.

Preparation of rice field: Rice should be planted by applying fertilizer, cow dung etc with traditional method after ploughing and leveling of land.

Selection of rice breeds: High yielding rice like BR-3 (Biplop), BR-11 (Mukta), BR-14 (Gazi), BR-2 (Mala) etc should be selected for culturing fish and shrimp with rice.

Method of rice plantation: Rice seedling should be planted by row wise. In that case, space between row to row and seedling to seedling should be 20-25 cm and 15-20 cm, respectively. Space of 35-40 cm should be given after planting 5-6 rows serially. It helps to move fish and shrimp easily and natural fish feed can be produced rapidly by falling enough sunlight on water.

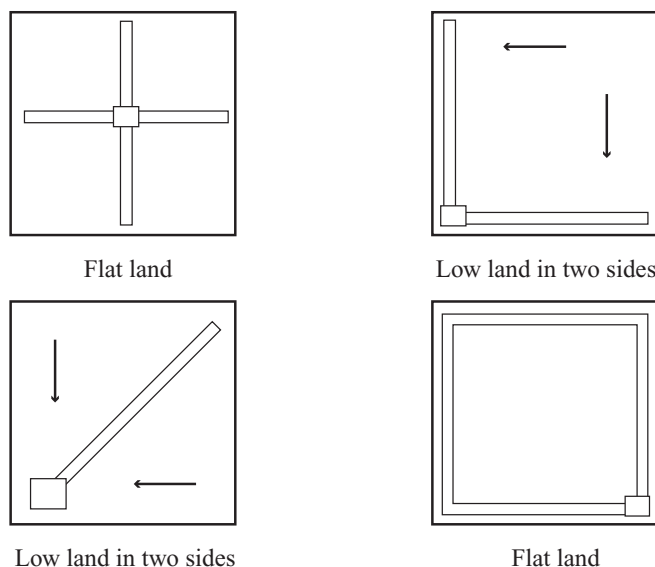


Fig: Several design for making ditch and drain in rice field

Selection of fish species: Quick growing fish like carpio, shwarpunti, tilapia should be selected that can survive in less water and oxygen due to insufficient water in rice field, can tolerate high temperature and become suitable for fishing within the rice cultivation. But few of rui, katla may be added to this culture. Besides, magur fries can also be released. But grass carp cannot be released because they may eat rice plant.

Fry stocking: Shrimp and fish can be stocked while rice plant is strongly attached with the soil after 10-15 days of rice planting. Fish and shrimp fries can be stocked at 15-20 and 40-50 per decimal; respectively.

Making and application of supplementary feed: Taking rice polish, oil cake and fish meal at 1:1:1 ratio and sufficient amount of atta making steaky by boiling in water are mixed to form paste (semi solid state). This should be supplied fish and shrimp after making small sized balls. This will be supplied at 3-5% of their body weight by making three parts of feed in every morning, noon and evening.

Management: Insecticides should not be used if fish is cultured with rice. If it is required to use insecticides, it should be applied by reducing water in field and arresting fish in ditch/drain. Fishes are to be helped to release again for moving towards the field by irrigation after 5 days of applying insecticides. Irrigation should be maintained immediately if reducing water in field. If showing any disease in fish, they are taken to the ditch and applied 1 kg lime per decimal.

Collection of rice, fish and shrimp: At rice harvesting time, they are to be harvested by reducing water in field and taking fish and shrimp into the drain and ditch. If water remains in the field after harvesting rice, or if water can be supplied, fish culture can be carried out until starting the cultivation of next crop.

Section-6

Method of Rearing Domestic Animal and Poultry

Cow Rearing:

Livestock and cow rearing are closely related each other for improvement and development of agricultural sector. It is said that merital development of a nation depends on how much milk they can take. Today Agriculture has developed in those places of the world where milk production and their uses have been established as industry. In our country, cow rearing is being established almost as an industry. There are five types of improved cow breed. These are Holstein Friesian, Jersey, Sahiwal, Shindhi, Red Chittagong etc. The production efficiency of these breeds is almost good and their production efficiency will be increased if they are reared and bred in a scientific method.

Housing for cow

Housing of cow is called cow barn. In our country, cow is reared by keeping in cow barn. Cow barn should be built up on high and dry place so that faeces can properly be cleaned out and the barn become dry. Cow barn should be built up in such a way that lighting and proper ventilation will be available and rain water, temperature, humidity etc. can be controlled. Cow barn must be the safe shelter for cow. Cow barn should be larger in size. In every cow barn, feed and separately water should be managed.

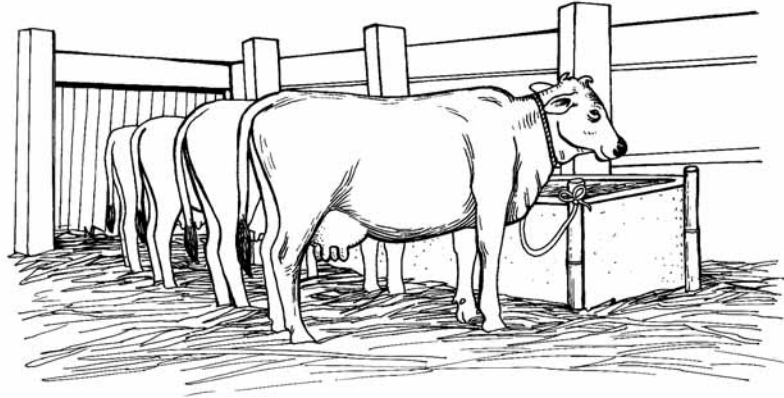


Fig: Dairy cow in the farm

Caring for cow:

The objective of caring for cows is to keep them for more efficient. During pregnancy, parturition and milking, care should be given with special importance. Special emphasis should be given on regular washing, dehorning, hoof trimming of cows etc. This caring keeps the cow healthy and affects the production performance. During pregnancy, special care should be taken because the calf is growing inside the body of cow. In this time, cow should be provided sufficient amount of concentrates. Before and during of parturition, care should be provided to cows by keeping them in separate place. Cows are kept in a flat area. During pregnancy and parturition, proper care should be provided to cow. Fetus may be damaged if careless during pregnancy. Moreover, cow may lose the breeding and pregnancy ability. Cow should be observed for 2-3 hours in a quiet environment during showing symptoms of parturition. If the parturition is not going smoothly, it is worth calling a veterinary doctor. Colostrums must be provided to calf for increasing disease prevention ability and helping the calf growing properly. Cow gives colostrums for 5-7 days and after that gives milk. During milking, keep the cows free from any excitement and milking should be performed quickly. Another objective of cow rearing is to keep cow free from any insects and flies.

Feeding of cow:

Quality feed is necessary for cow's body growth, development and repairing of cells and tissues, heat and energy production, fat storage, milk and meat production, achieving breeding ability, fetal development during pregnancy, etc. Special importance should be given on adequacy of carbohydrate, protein and fat during feed supply, because all kinds of feed nutrient are very important for cow's body growth. To meet up the animals' requirement, all kinds of nutrients have to be available in mixed feed with sufficient quantity and properly balanced. So, balanced feed is required for cow for their complete development and production. Generally, cow's feed can be classified in to three groups, such as Roughages, concentrates and feed additives. Roughage includes mainly straw, green grass, tree leaves, hay, silage etc. Concentrate includes mainly cereal grains, wheat bran, rice polish, oil cake etc. Besides, bone meal,

various vitamin –mineral premix are included in vitamin and mineral. The feeds have to be collected according to requirement and supplied to the cow. The amount of feed required to supply cow can be calculated by Thumb-rule method. Such as-

1. Daily straw and green grass have to be provided to cow that how much it can intake a day.
2. 1.5 kg concentrates have to be provided to cow for its body maintenance and 0.5 kg concentrates have to be provided along with straw and green grass daily for 1.0 liter milk production.
3. 40-50g bone meal and 100-120g common salt will need to be provided.
4. Moreover, clean, organism free feed and drinking water has to be provided to dairy cow.

Hygienic rearing of cows and disease prevention:

Hygienic rearing may be defined as the hygienic means which have been followed for livestock production. These are-

1. To facilitate lighting and ventilation during house making and protect disaster.
2. To keep feeder and drinker neat and clean.
3. To avoid rotten, stale and dirty feed and water.
4. To provide always fresh feed and water.
5. To follow the microorganisms free method during breeding and parturition.
6. To drain out faeces and urine quickly.
7. To separate sick cow and dispose dead cow.
8. To follow deworming practice regularly
9. To apply vaccination programme against the infectious disease etc.

Regular observation of cow and treatment:

Sick animal can be identified by regular observation. Regular vaccination programme is applied to cows for preventing different diseases. Cow may be affected by black quarter, anthrax, foot and mouth disease, goiter, rinderpest, mastitis, parasites etc. It is wise to take advice from a Veterinary doctor if any disease outbreaks.

Calf rearing

A cattle in early stage is called calf. Generally, after birth to one year of old cattle is known as calf. The future of dairy farm depends on the satisfied condition of calves. Because, today's calf will be the future milk producing cow, improved type breeding capable bull or meat producing cattle. So, it is an important factor of calf rearing in Animal Husbandry. Cattle with very early stage is very sensitive to disease. There are more than 24 per cent calves of the total livestock rearing in our country. That's why, to get healthy calf, it is required for proper and sufficient balanced ration for pregnant cow and on the other hand, proper care is also required during parturition and for a new born calf.

Housing for calf

Generally, average birth weight of a calf with native breed is 15-20 Kg, although birth weight of improved and crossbred calf is about 25-30 Kg. Space requirement for calf housing depends on its size. Housing for a big sized calf is made by considering the space of 35 square feet (3.25 square meters). Calf house should be made in place where sufficient light and wind can pass through. Calf house may be made by either soil or concrete, but proper drainage system should be available. Space requirement for a small sized calf is 12 square feet (1.11 square meters). Straw can be used as bedding materials in calf barn. In concrete floor, care should be taken for keeping floor free from mud or dampness.

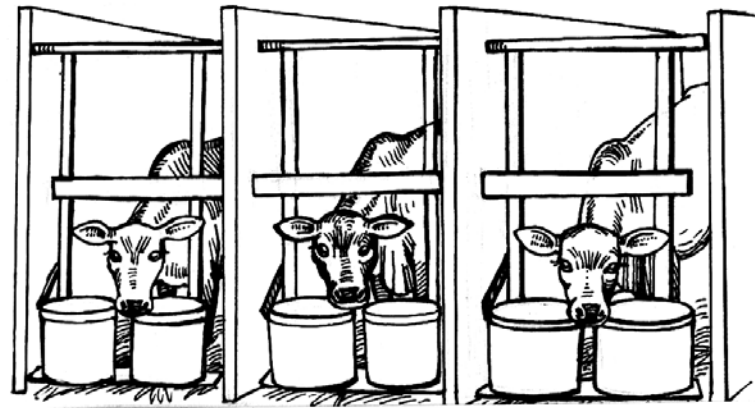


Fig: Calf in small barn of house

Caring for calf

Caring for calf means providing feed to calf, keeping it free from diseases, taking care etc. In our country, there is no planning for caring calf separately. But it is an important factor. It is necessary for calf to rear or provide special care during the time from birth to until they reach maturity.

Teaching calf for suckling milk from cow

Just after birth, many of the calves can not take milk by sucking teat of cow. That's why calf is habituated for taking milk by placing teat into its mouth. Calf may be fed milk of different cow when its mother going into less productive. In early stage, calf should be fed milk of 37.50°C temperature. Generally, milk is provided to calf by using bottle or bucket. It is wise if pure milk is provided by mixing with water at the ratio of 1: 2. After milk feeding, bottle must be washed out properly.

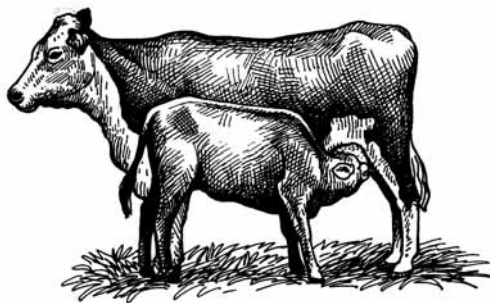


Fig: Calf is suckling milk from its mother provided to



Fig: Milk is being calf by using bottle.

Calf identification or tagging in farm level:

It is necessary for a big size farm although it is not so required in small size farm. It has no alternate to develop livestock breed and record keeping. Generally, animals are identified by fixing tag with number in the ear.

Required amount of feed supply, cleaning out faeces and keeping bed clean:

There is no alternate in required amount of feed supply for proper body growth of calf. Generally, feed is supplied based on body weight. Feed should be supplied regularly according to feeding chart and requirement of growing calf from birth to until self-sufficient. Faeces should be drained out properly from the calf house for their rearing with healthy condition. Calf house has to be kept clean by regular changing of bedding materials. The house where calf lying down, has to be kept enough dry.

Timely taking calf into and outside of the house:

Calf should be taken into and outside of the house timely. Calf should not be kept in the confinement condition all day long; on the other hand, it should not also be kept open area for all day long. Calf may be affected by respiratory infection.

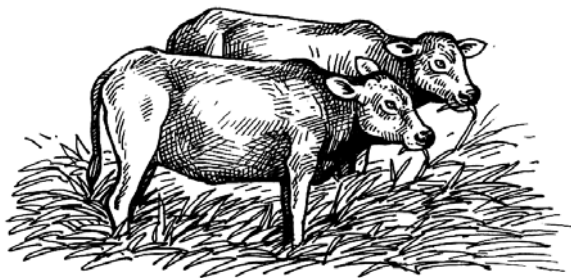


Fig: Calf is habituating to eat grass in the pasture land.

Daily observation and treatment of calf:

In calf rearing management, regular observation and medicine taking are among them. If the calf does not grow properly during this time, in future, it will not become a cow with well productive. Regular vaccination should be followed to prevent disease outbreaks in calf. Diseases of scire, pneumonia, fungus, black quarter, worm, wart may be observed in calf. If disease outbreaks in calf, advice should be taken from veterinary doctor.

Sheep rearing

Sheep is a gentle animal. They like to eat grass in the pasture land and move around together. Their breeding efficiency is high and they give birth 2 times in 15 months. So, if starting to rear sheep, farm size will be increased within few years and achieve profit in business. They can only live on grass. But if provided concentrate feed, well production can be achieved. Sheep is reared for wool and meat. There is not so good breed in this country. Sheep in Bangladesh produces coarse wool. So, they are not popular for wool. Sheep is reared here for meat. Although, sheep wool is very valuable and popular in the temperate zone of the world. Blanket, shawl, sweater, jacket are made of sheep wool. Coarse wool is used for making carpet. In spite of these qualities, sheep rearing is not popular due to lack of pasture land and steps.

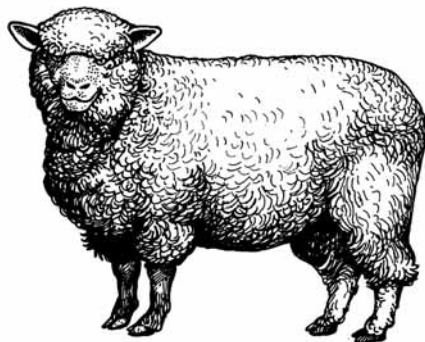


Fig: Merino sheep with fine wool



Fig: Karakul sheep with coarse wool

Housing for sheep

Housing for sheep is not so important. Because, they graze around the field all day long for feed, although housing is required for the following reasons:

1. To take rest at night.
2. To protect from wild animal.
3. To protect from heavy wind and rainfall.
4. To perform milking from high producing sheep.

5. To take care for pregnant animal, parturition and for lamb.
6. To clip sheep wool.
7. To protect from thief.

Three types of houses are used for sheep rearing. Such as,

A. Open or extensive B. Semi open C. Intensive. Housing for sheep is made for sheltering at night by considering weather and climate. Floor of sheep house should be either ground level or on slat.

A. Open house: This house is suitable where rainfall is less. Open house can be prepared by making fence around a specific area. The house has no roof. A group of sheep take shelter here at night after grazing over day. Straw is used in the floor.

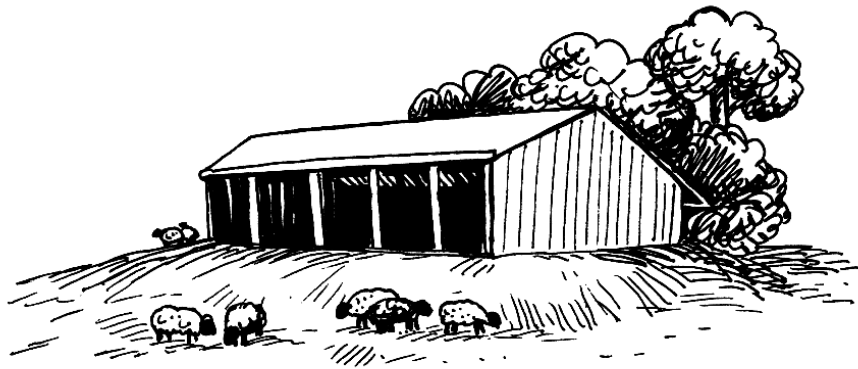


Fig: Open house of sheep

B. Semi open house: When a place with roof is prepared at the one corner of a specific place of open house is called semi –open house. Semi-open house may be used in the area where rainfall is not frequent.

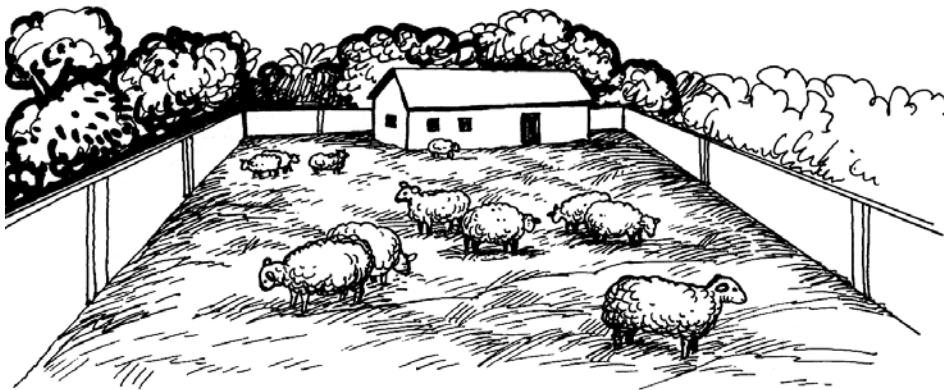


Fig: Semi open house for sheep

C. Intensive house: This type of house is more suitable in the area where excessive rainfall is common. Intensive house is fully covered by roof. Sufficient light and ventilation should be available in this house. Floor of the house may be concrete or semi-concrete.

Floor space allocation for sheep with different ages

Sheep weight/age	Floor on slat (square meter)	Floor on ground level with straw (square meter)
Ewe without lamb (45-68 kg)	0.75-0.95	1.0-1.3
Ewe with lamb (45-68 kg)	1.0-1.4	1.30-1.75
Ram (Adult male) (32 kg)	0.55-0.75	0.75-0.95
Ram (22 kg)	0.45-0.55	0.65-0.95
Lamb (6 weeks)	-	0.4
Lamb (2 weeks)	-	0.15

Caring for sheep

Proper care should be required to keep sheep healthy, strong and active and to get more production. Sheep wool should be cleaned with the help of brush regularly. Dirt of wool will be come out. Sometimes, chemical has to be applied on the body of the sheep to destroy external parasites. Before clipping (cutting wool) of sheep, washing should be performed.

Feeds for sheep

Sheep can live on any type of feed. It is a ruminant animal as like as cattle, buffalo and goat. Feed classification of sheep is similar to cattle and goat. The ration of sheep contains more roughage (fiber) than concentrates. More concentrated feed should be provided to mother ewe than pregnant ewe. Concentrated feed of 200-250g should be added daily at feeding chart for ewe before one month of parturition.

Feed chart for meat producing sheep-

Ingredients	Quantity (%)
Broken corn	40
Molasses	5
Wheat bran	10
Oil cake	9
Dried legume grass	36
Total	100

Task:

Show the class teacher after estimate the daily requirement of roughage and concentrated feed for five meat producing sheep

Feed chart for pregnant ewe:

Ingredients	Quantity (%)
Broken wheat	45
Oil cake	10
Molasses	5
Silage of maize	20
Dried legume grass	20

Feed chart for mother ewe:

Ingredients	Quantity (%)
Good quality dried legume grass	80
Broken corn	13
Oil cake	4
Wheat bran	3

Caring for newborn lamb

According to body weight, colostrums should be given to newborn lamb up to 3-4 days of parturition. It develops body immunity.

Prevention and treatment of sheep diseases

Sheep is kept in a clean environment. Routine Deworming and vaccination programme should be followed for all stages of sheep. Sheep is mainly affected by anthrax, black quarter, mastitis, foot and mouth disease, skin disease, worms, external parasites etc. Treatment should be provided to sick sheep according to the advice of Veterinary doctor.

Method for duck rearing

Bangladesh is a riverine country. The weather and climate of this country is suitable for duck rearing. There are many canal-beel, ditch-drain, haor-baor, pond and river in Bangladesh. Many duck farms have been commercially established in Sylhet, Mymensingh, Kishorgonj, Jessore of Bangladesh. Farmers in village rear duck by traditional method. But there are many methods available for duck rearing.

1. Open or extensive method
2. Semi-intensive method
3. Intensive method
4. Floating method

1. Open or extensive method:

Most easy method of duck rearing is open or extensive method. In the village of Bangladesh, ducks have been reared by this method. In this method, ducks are released in the morning and kept in confine condition at night. Normally, no feed is given to duck. Because, they take feed by searching all day long from natural source like small fishes, snails, aquatic plants, various grains and insects. Duck lays at morning and that's why they are kept in confinement condition up to 9 o'clock morning in this rearing method. This method is most suitable and profitable in the areas of our country where fallow land, haor-baor and rivers are available. But in extensive method, there are some advantages and disadvantages of rearing duck which are discussed below.

Advantages of duck rearing in extensive method:

1. Requires less labour.
2. Low feed cost.
3. Low cost for making house.
4. Well adaption with the environment.
5. Well body growth and production.

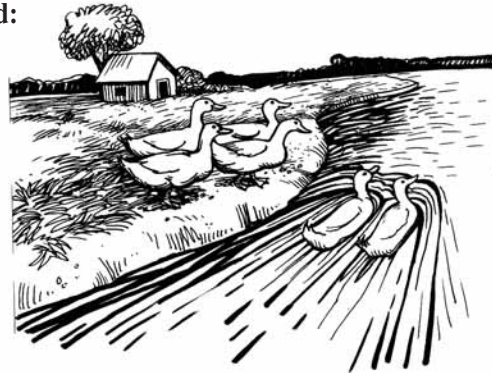


Fig: Duck rearing in extensive method

Disadvantages of duck rearing in extensive method:

1. Requires more fallow lands and water bodies.
2. Ducks may be affected by wild animals.
3. They may be affected by harsh weather.
4. Regular observation can not be maintained.
5. Sometimes, they destroy land crops.

Intensive method

In this method, ducks are kept in confinement condition all times. This method is most suitable for duckling (young duck) rearing. Intensive method is of two types. Such as-

1. Floor system.
2. Cage or battery system.

Floor system: In this system, ducklings are reared on floor in a confinement condition. Straw can be used as bedding materials in this method. Care should be followed to prevent damaging litter by feed and water.

Battery or cage system: In this system ducklings are reared in the cage. Each duckling requires 0.07 square meter floor space. This method is more suitable for duckling rearing.

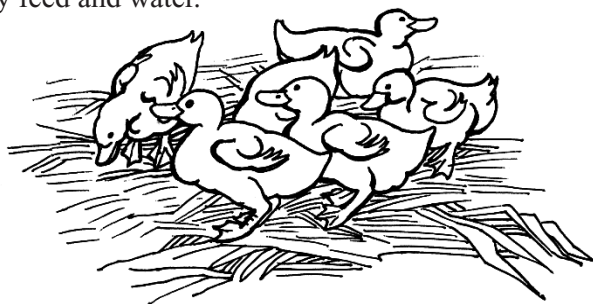


Fig: Ducklings rearing on floor

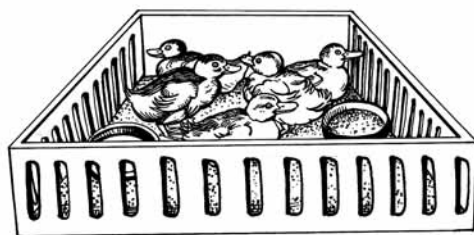


Fig: Ducklings in cage

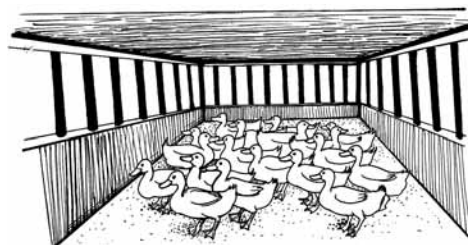


Fig: Adult duck rearing in intensive method

Advantages of intensive method:

1. Uniform feed intake.
2. Easily disease prevention.
3. Requires less labour.
4. Wild animals cannot affect the ducks.
5. Requires less space for each duck.

Disadvantages of intensive method:

1. Requires more feed supply.
2. Requires high cost for making house.
3. Lack of free light and air for ducks.
4. High equipment cost.
5. Need intensive care.
6. Ducks cannot get facility for swimming.

Semi-intensive method

Ducks are kept in house at night and they are released for free range near a fixed water body or a place of homestead area. Each duck requires about 0.93 square meter (nearly 10 square feet) floor space in a fixed place. If the place is not be a water body, artificial water body, drain or a water reservoir has to be made for their swimming. Here, ducks can swim and take water.

Advantages of duck rearing in semi intensive method:

1. Ducks can get facility for swimming.
2. Growth of body remains normal
3. Less labour is required.
4. Equal feeding is confirmed.

Disadvantages of duck rearing in semi intensive method:

1. Requires high cost for duck rearing.
2. Intensive care is needed.
3. Feed cost is more.
4. Equal feeding is confirmed



Fig: Ducks rearing in semi-intensive system

Duck rearing on floating house

In this method, floating house is being made for duck. This method is suitable for rearing of growing and adult duck. Houses are constructed on water near the bank of big pond, lake or river considering the number of duck. Though the construction cost is some extent more, the cost of feed is lower. The drum is used to prepare floating house. The ducks move all the day for having food and taking shelter in the houses at night. Generally, the duck reared by this method is much profitable in low lying areas where there is heavy flood.

Prevention and control of duck diseases:

The duck should be kept in a neat and clean place. Regular vaccination and deworming should be provided to ducks. Ducks are mostly infected by duck plague, cholera, parasites etc. Treatment should be provided to diseased duck according to the suggestions given by the veterinary doctor.

New words: Haor- baor, Floating method, Adaptation, Water body, Artificial water body, Duck plague.

Task: The learners will write down the advantages and disadvantages of raising duck by floating method and will present in the class.

Section-7**Raw Materials of Industries: Agro- materials**

Agriculture is a great blessing for human being to be alive and the main pillar for establishing civilization and improvement. In view of improving living- life, agriculture also provides raw materials for industries. Again it supplies wood, shrubs, grasses as the raw materials for increasing house- hold beauty. Beside tea, coffee, sugar, cotton etc. special agro- materials, bamboo, wood, coconut husk, mango etc. are also playing their roles in different industries as industrial raw materials. The small cottage industries in Bangladesh have started through the bamboo- stick (bet). Therefore, we all should know what types of materials are produced from bamboo- bet, what the suitability of coconut husk is and what types of materials are produced from mango. The uses of some agro- materials are discussed below:

Mango made foods and their uses

Mango is called the king of fruits. Among all the fruits in Bangladesh, mango ranks the first regarding test. Mango is a crop of temperate regions. Including Bangladesh, India, and Pakistan in Asia mango is cultivated most of the countries of Africa. But in respect of production, India ranks the first and Bangladesh ranks the eighth position. More or less mango grows in each district of Bangladesh. But the districts where the production is higher are- greater Rajshahi, Pabna, Dinajpur, Kushtia and Khulna. More than 80% of the total mango production come from greater Rajshahi.

Green mango and ripe mango on processed various types of tasty foods like mango morobba, mango chatni, mango catchap, Amchur, Amsatta, mango juice etc. are being produced.

Coconut made foods and their uses

Coconut is a cash and oil crop. Coconut plant is used in various aspects. The inner portion (endosperm) of coconut is used as human food and from it oil can also be extracted. The rope, mat etc. are prepared from coconut husk. From coconut leaves, sweeping brush is also produced.

Young fruit of coconut is called green coconut. The water of green coconut is tasty and nutritious. The water of green coconut is also used as diet. The people of the coastal areas use coconut endosperm (inner portion of coconut) in curry. In most of the families of Bangladesh, coconut is used to prepare dough (kheer), payes, sweetmeat etc. From coconut, oil for head use and edible oil are prepared. The coconut is also used to prepare glycerin soap and other cosmetics.

Coconut husk

A large number of coconuts are produced in Bangladesh throughout the year. Much amount of coconut husk is also obtain along with coconut production. Various house- hold materials are made from coconut husk.

Such as- Cooshon of big cot, Wallmet, Papoose, Rope etc materials can be prepared.



Fig: Coconut husk

Importance of using agro- materials in industries as raw materials

Uses of bamboo and bamboo made materials

Bamboo is a grass plant. It is an important non- woody, forest and natural wealth. It is being used as the alternative of wood in furniture, house buildings and house- hold beautification from the ancient time. The most important is that bamboo is used in various works of family or households. Its uses are started from house construction and house- hold materials and extended to large industries. In large industries, paper, particle board, ply wood, dhaotin even panels are also prepared from bamboo. The necessary materials like chatai, doal, beam, aur, house- hold pillar, toys, musical instruments, basket, winnowing fan, fishing net, polo etc. are used from the ancient time using bamboo.



Fig: Bamboo

In the modern world, a great improvement in handicrafts and small cottage industries in the home and abroad has been found. Now a day, laminated bamboo floor and wall cover, mat, cushion, seat cover even shoes are also prepared from bamboo.

Classification of bamboo industries

The bamboo industries can be divided into the following classes. Such as:

1. Paper industries
2. Construction industries
3. Small and cottage industries

Paper industries

The muli bamboo is specially suitable for paper industries. The high quality paper can be prepared from the pulp obtained from muli bamboo. As a by- product of paper, rayon is also prepared. Paper industries have been developed in various places of Bangladesh. Most of the bamboos of Chittagong hill tracts are used in these industries. Beside paper, particle board, ply wood, Flack board, dhaotin, panel board etc. can be prepared from bamboo.

Construction industries

The bamboo is also used in different construction industries. Among the construction industries, house- holds and building constructions are the main. The bamboo is used in the various works involved in house- hold construction like providing pillar, fence, beam, aur etc. The bamboo is also used in the construction of different large sized buildings.

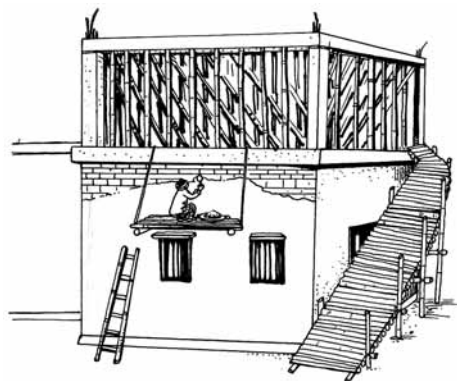


Fig: Bamboo used in building construction

There are many other construction industries where bamboo is used from the past. For example, to construct bridge or sako; mastul, Chhai, bottom of boat; cart, yoke, harvesting machine etc., bamboo is used. The bamboo is also used prepare electric pole, fishing chai, straight net etc. To prepare stand of dharma jal, macha for climbing vegetable plants, lecture theater, gate etc., bamboo is used regularly. In hilly areas, wells are prepared by bamboos which are called Artesian wells. Using these wells, land is cultivated in the hilly areas.

Small handicrafts

Bamboos are used more in small handicrafts. Because, the production and uses of this small handicrafts has been increased. All types of bamboos belong to the baying small handicrafts. Under this industry, chatai, dola, winnowing fan, zhaka, sieve, khatcha, toys, pen, cap, vase, light stand, rod, stick, even tooth pick, book self etc. are produced.

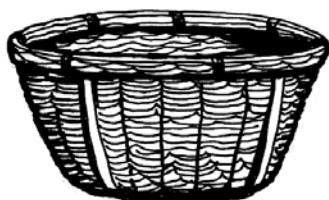


Fig: Tukri



Fig: Polo

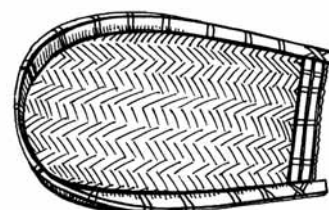


Fig: Winnowing fan

Medicinal bamboo

Bamboo is not only used in preparing paper or house- hold materials. Bamboo is also used in manufacturing medicine. There are many varieties of bamboo. Among these, golden bamboo is used in different human normal diseases like diphtheria, urinary diseases, gall etc. The highly effective medicine for escaping from these diseases is this golden bamboo. The bamboo panicle, leaves and roots are used as medicine. These medicines must be prepared and used in accordance with the suggestions of 'Hakim' i.e., herbal doctor.

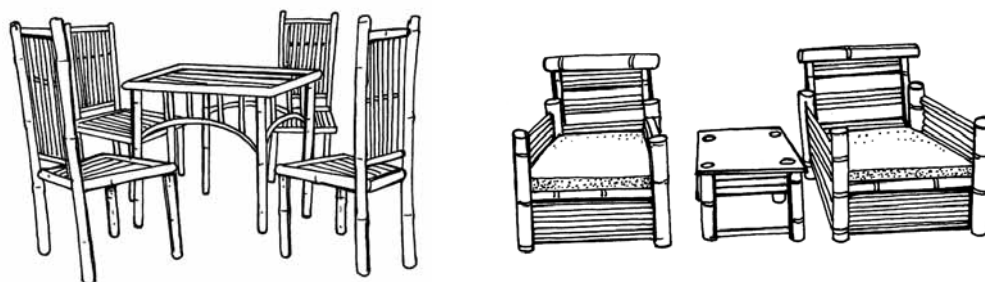


Fig: Bamboo made chair and sofa

Task: The learners will visit the place where the baskets are made and will write down the steps involved in basket making. Thereafter, they will practice themselves.

Bet and its uses

Bet is a natural forest resource in Bangladesh like wood and bamboo. There are various types of bet found in the forests of Bangladesh. The agricultural lands are not used to produce bet. A large amount of bet is produced naturally in Sylhet and Chittagong hill tracts regions. Bet belongs to the family of plum and coconut but its plant is spiny vine and shrub in nature. It bears fruits, which is called bet fruit.



Fig : Bet plant

Bet made materials

Bet is well known to all due to its industrial quality. The stem of bet plant is used in bet industries. The stem of bet is hard but is flexible and suitable for sawing.

Making furniture from bet

Furniture made from bet is originally natural. There is no artificiality in it. Furniture can be made by using bet as like as thread and embracing any hard materials (rod, bamboo) with it. Again by drying thick stem of bet and making hard structure with it sofa, chair, table, book self, cot, dolna, mora, shoe stand, corner self, wear drops, rocking chair, easy chair etc. furniture can be made.

Before making furniture, it is necessary to cut the bets into appropriate sizes and thereafter be treated. Making solution by boric acid and water at approximate rate in a chari and deeping bets in this solution for one week, they can be treated well. Thus, ghoon or other insects and mites will not infest.

Bet made industries

The uses of bet are extensive. Bet made materials are the identity of rural industry. The bet made materials can be divided into the followings:

1. Light construction industries
2. Bunon industries
3. Small handicrafts
4. Mixed industries

Light construction industries

Bet made light construction industries mean the furniture made by thick stem of bet which can bear light weight. The main examples of light construction industries are- sofa set, chair, cot, partition, shelf, table etc. The bet which are used in these industries are comparatively thick and larger in amount. To use this bet, it is necessary to have efficiency in art. There is a heavy demand of light construction Industries in the luxuriant community of home and abroad. Generally, golla bet, udam bet, kadam bet etc. are used in these materials.

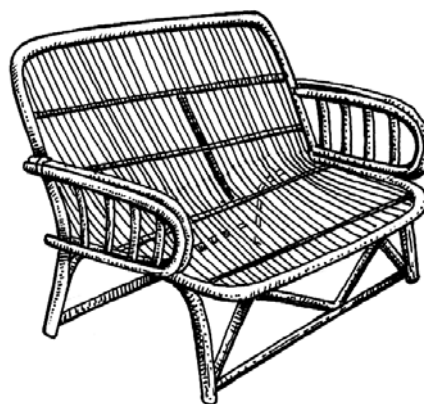


Fig : Sofa set made by bet

Bunon industries

In bunon industries, narrow and flexible bets are used. The narrower sheets are also got by sawing this bet. This narrow sheet is called beti. This beti is used in bindings and bunon works. By bunon works, the light construction industries are made fancy and attractive. For bunon industries, bandoriak and jail bet are used.

Small handicrafts

Actually, all the bet industries are handicrafts- either it is small or large. The beautification materials that are produced using unnecessary residues of construction industries and bunon industries are called bet made small handicrafts. The example of bet made small handicrafts are toys, flower basket, pen stand, bet made dhama, shoe rack, mora, vase etc.



Fig: Bet made dhama

Mixed industries

The materials which are made by mixing bamboo, wood, plastic, nylon, steel etc. with bet are called bet made mix industries. Mixed industries are produced by using wood, bamboo etc. instead of thick bet to make dolna, mora, rack, shelf, chair where there is lack of thick bet. Again, where there is lack of thin bet, nylon or plastic beti is used with thick bet to make cot, box, sofa etc. instead of thin bet.



Fig: Flower basket

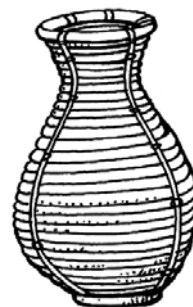


Figure: Vase

Chapter 8 Medicinal Plants and their Uses

Medicinal plants

There are various types of plants in our surrounding environments. In our everyday life, we use these plants and their products in many ways. We are dependent on the large plant kingdom to meet all the demands of our life including food, cloth, housing, education and treatment. We have acquired a lot of knowledge about this aspect. We have seen or heard that in our households specially if the children are affected by influenza or diphtheria, are fed juice of tulshi leaf mixing with some drops of honey. Thus their influenza or diphtheria is controlled and they feel easy. Suddenly if any part of body becomes wounded, the bleeding can be blocked instantly if mesh marigold or bermuda grass leaf mesh is placed on the wound. The patient gets well drying wound within two- three days. Thus, the plants of our environment, which are used in the control of our diseases, are known as medicinal plants.

Identification of medicinal plants

Once, our country was rich in medicinal plants. The fields, roads, forests all are rich in numerous medicinal plants. Now- a- days, due to the increase of population, multiple uses of lands has been increased. Besides, due to ignorance, negligence and uncared, the main origin of these medicinal plants, the natural source forests, have been decreased. Thereby those valuable tree resources have been decreased. In the mean time, many species have been extinct. At present, the sufficient medicinal plants exist here and there. We do not know them. Even we have no any idea about the uses

and qualities of these plants. We shall have to identify the medicinal plants of our surroundings and be aware of the uses and qualities of these plants. Consequently we can play a role on the control of the human disease of our country.

Medicinal plants



Thankuni



Tulshi



Kalomegh



Basok



Sarpagandha



Arjun



Haritoki



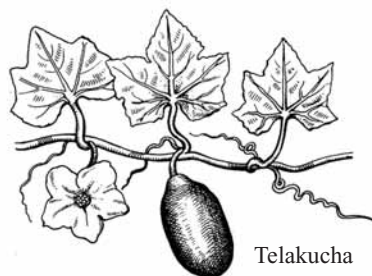
Canola



Bahera



Nisinda



Telakucha

Task: The teacher will bring the sample of medicinal plants; the learners will observe and identify those plants in group. They will prepare a list of the name of medicinal plants by discussing in group.

Medicinal plants and their uses:

The people of our country are being benefitted by using various plants to control diseases from the ancient time. Since these plants are used as medicine, these are known as medicinal plants or herbal plants. The identities and uses of some herbal plants are discussed below:

1. **Thankuni:** Thankuni is a small vine type herbaceous plant. From each plant node, roots are originated below the ground and branch and leaf above the ground. Leaves are simple, kidney type and alternate.

Usable part: Whole plant.

Uses: Thankuni is used in the control of intestinal diseases of children specially to control indigestion and discentry. Besides, Thankuni is life span increaser, memory increaser, and controller of skin diseases.

2. **Tulshi:** Tulshi is a well known herbaceous plant. It is normally 30 cm to 1 m in height. Leaves are simple, opposite, oval, scented. It bears flowers and fruits in winter.

Usable parts: Leaf.

Uses: Generally, juice of tulshi leaf is very useful for curing influenza and diphtheria. Tulshi leaf juice mixing with zinger juice and honey is fed to small children.

3. **Kalomegh:** It is a small herbaceous plant. It is normally 20 cm to 1 m in height. Leaves are simple, opposite, some extent long. Leaves are bitter. It bears flower and fruits from the last part of rainy season to winter.

Usable parts: Whole plant, specially leaves.

Uses: The juice of this plant is very effective medicine for controlling fever of children, indigestion and liver trouble.

4. **Basok:** It is a shrub. Leaves are simple, opposite, long.

Usable part: Leaf extract.

Uses: It is mostly used in controlling diphtheria. Taking juice of basok leaf mixing with zinger juice and honey in equal proportion is very effective.

5. **Sarpogandha:** Sarpogandha is a perennial herb. It bears three leaves on each node. It bears flowers and fruits in rainy season. The fruit on ripening looks black.

Usable part: The juice of sarpogandha root and leaf is used in high blood pressure. It is also used in the treatment of mad.

6. **Bahera:** It is a branched tree plant. Leaves are simple, petioles are long. Flowers are yellowish white and oval. The fruit bears a single seed. Fruits are round or slightly long.

Usable part: Fruits and seed.

Herbal uses: Bahera is one of the fruits of trifala. If one or two inner part of seed (like groundnut), is eaten by biting at two hours intervals and twice in a day, asthma disease is controlled. It is beneficial to eat bahera crush with water in the morning and the evening. Fruits of bahera are used in stomach diseases, piles, hard motion,

diarrhea and fever. Fruits are the effective medicine for heart, lungs, nose, throat diseases and indigestion. The oils obtained from seed keep the head cool and control hair shattering.

7. **Haritoki:** It is a tree plant. Leaves are simple, alternate, sub-oval, petiolated. Flowers are white in color and small. Fruits are long and slightly ridged.

Usable part: Fruits and wood.

Herbal uses: As a herbal medicine, haritoki is one of the fruits of trifala. Using crush of haritoki fruits with salt piles disease can be controlled. If haritoki crush is smoked inserting in a pipe, asthma disease can be controlled. If haritoki ash with cream is applied on wound, it gets well. If haritoki crush is used with sugar and water, conjunctivitis disease of eye gets well. Green fruits are used in dysentery and ripen fruits are used in anemia, pancreatic disease, heart disease, rheumatic disease and throat injury. Fruit crush is used to control dental disease. Haritoki increase strength, viability and control senescence.

8. **Arjun:** Arjun is a medium to large sized tree. Stem is simple and erect, smooth and attractive. The bark can easily be separated from the plant. Leaves are simple, long, oval. Flower is yellowish, small having bad odor.

Usable part: Leaf, bark, fruit and wood.

Herbal uses: The juice of green leaves is used in controlling dysentery. If arjun bark by well meshing is used at every morning with sugar and milk, all heart diseases get well. If anybody has low blood pressure can be controlled by using arjun bark. Using juice of bark stomach diseases and piles are controlled. By taking bark mesh with milk blood dysentery get well. By applying fine crush of arjun bark on the face mixing with honey mehta spot is disappeared.

9. **Anole:** It is a medium sized tree. Leaves are simple, leaflets are arranged in opposite direction. Flowers are small, greenish yellow. Fruits are succulent, fleshy, green, round, tasty and nutritious.

Herbal uses: Juice of anole leaves is preventive to dysentery and tonic. Fruits are rich in vitamin and one of the fruits of trifala. Juice of fruits is beneficial for curing liver, stomach diseases, indigestion and diphtheria. Using anole fruit with trifala anemia, hepatitis, skin diseases, hair shattering etc. diseases cured.

Usable part: The concentrated and lubricated juice released from leaves.

Herbal uses: The concentrated lubricated juice released from leaves is the effective medicine for hard motion. It plays an effective role on the treatments of un-hungriness, hepatitis, leukemia, piles, cut, burnt and wound. By mixing anole with cosmetics quality of cosmetics is improved.

11. **Telakucha:** It is a vine type herbaceous plant. This plant is found to grow spontaneously in the forests and jungles.

Usable parts: Stem and leaf.

Herbal uses: The extract of stem and leaf of this plant is extensively used in the treatment of diabetics. Its extract is used in influenza, fever, asthma and senselessness diseases. Applying leaf mesh by making layer on skin diseases is very effective.

Task: Present group discussion on the name of medicinal plants and their uses.

The necessity of various plants having medicinal value:

From the very ancient time, the various plants having medicinal value have been playing effective roles on controlling diseases. The importance of medicinal plants on the large improvement in modern medical science is boundless. It is very popular to the most of the people of our country to control diseases by medicinal plants. Because the treatment systems by medicinal plants are easily available, low costly and it has no any side effect. For that reason, the ayurvedic and unany treatments having quality of medicinal plants, has acquired much popularity in our country.

Although the improvement of modern treatment systems has reached at their higher level, people are feeling the necessity of the treatment systems with ancient medicinal plants. The many countries in the world have been started research on the improvement of herbal medicine. The possibility of cultivating medicinal plants in large scale and improvement of pharmaceutical industries and country's economy is very shiny in Bangladesh.

Task: The teacher will say to the learners to submit a report preparing on 'Medicinal plants in controlling diseases.'

Exercise

Short Answer Questions

1. Write down the characteristics of HYV rice.
2. Write down the names of two varieties of aus, aman and boro rice.
3. Write the name two varieties of deshi jute and tosa jute.
4. How many types of sucker are?

Descriptive Questions

1. Write down the rule of applying urea, TSP, MP, gypsum and zinc fertilizers in rice field.
2. Make a list of different diseases and insect- mites of rose and describe the control measure of any one disease and one insect.
3. Describe briefly the cultivation method of banana.
4. Write down the importance of agricultural products as raw materials of industries.

Multiple Choice Questions

1. Which insect infest at the milk stage of rice?

a. Stem borer	b. Rice hispa
c. Rice bug	d. Rice leaf roller

2. The characteristic (s) of Gazi rice is-

- i. Plant is dwarf
- ii. Leaves are slant
- iii. High yield

Which one of the followings is correct?

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

3. Which one is the symptom of stem rot disease of jute?

- a. Black band spot on the stem
- b. Deep brown spot on the stem
- c. Infested area becomes cracked
- d. Blackish spot on the stem

Read the following passage and answer to the question number 4 and 5:

Tasfi Miah is a jute farmer. He cultivated C- C- 45 and Chin sura green varieties of jute in his two pieces of land this year. He cut C- C- 45 variety in the month of Ashar and Chin sura green variety in the month of Bhadra. He got 1500 bundles from each piece of land. He applied urea fertilizer during jute rafting.

4. The reason (s) for cutting jute at different times from the two pieces of land-

- i. Due to difference in maturity
- ii. Due to difference in fertility of land
- iii. Due to difference in variety

Which one of the followings is correct?

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

5. How much urea is needed for retting jute of Tafsi Mia?

- a. 15 kg
- b. 20 kg
- c. 25 kg
- d. 30 kg

Creative Questions

1. Aysha Begum lives at high house- hold in bill area. She succeed by cultivating spinach in 5 decimal area of house- hold with the help of training on vegetable cultivation obtained training from the department of youth improvement. After this success, she planned to cultivate spinach on the high ails of land situated in the bill.

- a. Write down the name of a variety of spinach.
- b. Explain the reason for top dressing urea in spinach cultivation.
- c. Determine how much manure was applied by Aysha Begum in her land?
- d. Analyse how the plans of Aysha Begum will influence the agricultural activities?

2.

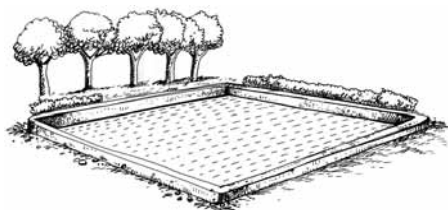


Figure-a



Figure-b

- a. What is called integrated cultivation?
 - b. How does the use of land become doubled? Explain.
 - c. Between the methods cited in figure a and b, of which production cost is lower? Explain the reason.
 - d. The methods cited in the figure, which method is the best for increasing family earning and nutrition. Explain judiciously.
3. The farmer Torab Ali, the inhabitant of the Meghna river bank, cultivated jute in his two acres of land. After some days, there was a large infestation of one kind of hairy insect in his jute field. Torab without any fare controlled the insects by appropriate management. Consequently due to having expected jute production from his field the other farmers of his area decided to cultivate jute in their land in the next year.
- a. What is the name of the institute involved in improvement of jute variety?
 - b. Explain the reason behind sowing seed at higher amount compared to normal dose.
 - c. Explain the method of controlling insects in the field of the farmer Torab Ali.
 - d. Evaluate what extent the farmers' decision will bring benefit in the socio-economic improvement of that area.

Chapter-Five

Afforestation

Plantation in the forest land, taking care and maintenance of them according to the scientific method is called afforestation. Through afforestation maximum forest materials are produced. The afforestation created through scientific and planned way in the house- holds, different organizations, road and bund sides, hilly areas and coastal areas is called social afforestation.



Fig: Coastal forest

The role of forest in creating environment suitable for living and its conservation is boundless. The forest created by the combination of large trees and, vines and shrubs in large areas of a country or region is called forest land. These forest lands are sometimes created naturally. But sometimes people create this by planting plants and taking care for their own needs. It is essential to have 25 percent forest lands regarding total land of a country to maintain natural balance. But the forest land in our country is very low compared to need amount. According to government information, the present forest land of our country is only 17 percent. According to UNESCO, the present forest land in our country is only 10 percent. We shall discuss about the extent of forest land of our country, their types and characters in this part. Besides, we shall learn forest conservation rules, forest nursery, seed for forest nursery, tree cutting and wood sawing, and coastal afforestation elaborately.

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

- ☐ • ☐ explain the nature of forest areas of Bangladesh.
- ☐ • ☐ cite the names of forest areas of Bangladesh.

- ☐ • ☐ describe the characters of different forests.
- ☐ • ☐ explain the forest conservation rules.
- ☐ • ☐ explain the necessity of forest conservation rules.
- ☐ • ☐ explain the forest nursery.
- ☐ • ☐ describe the forest nursery seed.
- ☐ • ☐ explain the technology of forest nursery preparation.
- ☐ • ☐ explain the rules of tree cutting.
- ☐ • ☐ describe the preservation methods of wood sheet or wood.
- ☐ • ☐ describe the methods of measuring sheet or wood.
- ☐ • ☐ explain the necessity of tree cutting and wood collection.
- ☐ • ☐ explain the idea of coastal afforestation.
- ☐ • ☐ describe the characteristics of plants used for coastal afforestation.
- ☐ • ☐ analyze the necessity of coastal afforestation.

Section-1

Extent of Forest Areas in Bangladesh

Forest is a valuable wealth of a country. The role of forest in socio- economic development and maintaining environmental balance is very important. According to government information, at present the total forest land in Bangladesh is around 22.5 lac hectares. This amount of forest land is 17 percent of the total land area of the country. This land is not equally distributed throughout the country. The most of the forest lands are situated in the east, south- east and south- west regions of the country. The amount of the forest lands in the north and north- western regions of the country is very low.

Types of forest land in Bangladesh based on the situation and extent

Based on the situation and extent of forest land, the forest areas of Bangladesh are divided into five groups. These groups are-

1. Hilly forest 2. Plain land forest 3. Mangrove forest 4. Social forest 5. Agricultural forest

The amount of forest land of Bangladesh is shown in the following Table-

The forest areas of Bangladesh based on the situation and extent (lac hectare)

Types of forest	Natural forest	Artificial or created forest	Total
Hilly forest	11.06	2.1	13.16
Mangrove forest	6.16	1.34	7.50
Plain land forest	0.87	0.36	1.23
Rural forest	-	2.70	2.70

Types and characters of forest area:

Hilly forest

Hilly forest is situated in the east and south-eastern regions of Bangladesh. The half of the total forest areas of Bangladesh is occupied by hilly forest. This forest is extended in the district of Cox's Bazar, Rangamati, Bandarbuns, Sylhet, Habiganj and Moulvibazar.

The main hilly trees of Bangladesh are-Garjan, Rajkarai, Chapalish, Talsur, Karai, Gamar, Champa, Jarul, Segun, Wild mango etc. Various types of bamboos also grow in hilly forest areas. Among these bamboos, there are Barak, Muli, Ura, Maral, Talla, Keitta, Nala etc. There are elephant, monkey, pig, deer, wild hen, fox, tiger etc, wild animals live in the hilly forest regions. There are various types of birds and insects found in the hilly forest regions. Beside larger trees, numerous species of plants including vines and shrubs grow in the hilly forest regions. There are ample influence of hilly forest areas on the weather, climate and environment of the country. The area of this forest is 13.16 lac hectares.



Fig: Hilly forest

Plain land forest

The forest of greater Dhaka, Tangail, Rangpur, Rajshahi and Comilla is called plain land forest. The main trees of this forest are Shal and Gajari. Besides, karai, rain tree, jarul etc, trees also grow in this forest. Due to the presence of residences near the plain lands, the human pressure is great in this forest. Therefore, the natural forest is decreasing day by day. In the mean time, in many areas the afforestation has become empty. In these areas, the government initiatives are being taken for social forestry. With the partnership of people social afforestation is being established in some areas. The Shal wood of this forest is of very high quality. The Shal wood is used in constructing house- holds, making furniture and in other construction works. The wild animals of this forest become almost extinct. At present little amount of tigers, deer, monkeys, snakes, dove, magpie robin and martin are found in some places. The total land area of this forest is 1.23 lac hectares.

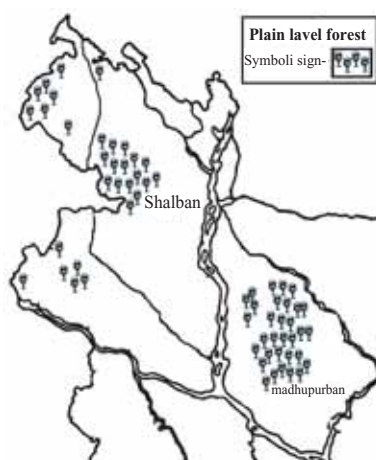


Fig: Plain land forest

Mangrove forest

This forest is situated in the south- western regions of Bangladesh. Since this forest is flooded by tidal water of sea at every day, this forest is also called saline water forest. The extensive areas of the southern parts of the districts of Khulna, Satkhira and Bagerhat are known as mangrove. The main plant of this forest is sundari. According to the name of sundari plants, this forest is named as Sundarbans. The most of the plants of this forest have upward facing aerial roots through which they can take oxygen for respiration. Because, it is not possible to uptake oxygen from the water stagnant soil through normal roots. Important trees of this forest are geoa, garan, pashur, keoa, byne, kakra, golpata and thick bet. The great royal Bengal tiger lives in this forest. There are panther, deer, monkey, python, various types of birds and insects live in this forest. Crocodiles and other aquatic animals live in rivers and canals of sundarban. Every year, a huge amount of honey and wax is found from sundarban. The sundarban is the historical forest of Bangladesh. The most largest and resourceful mangrove forest of the world is the sundarban. The total area of this forest is 6000 square kilometers.

This forest is situated in the three places of Bangladesh. 1. Chakoria 2. Teknaf 3. The sundarbans of Khulna.

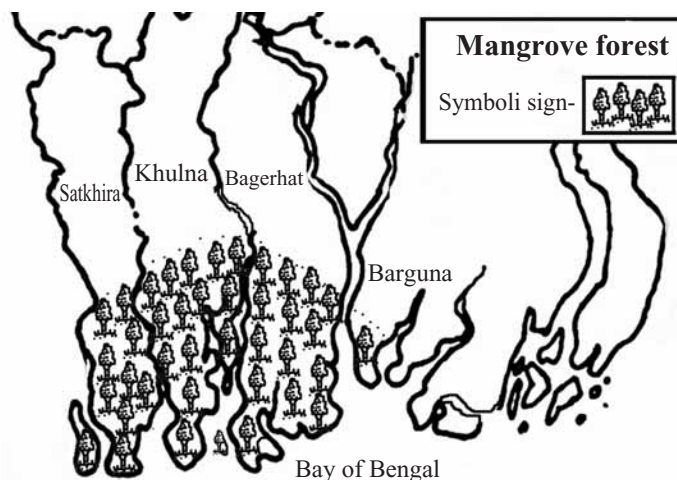


Fig : Mangrove forest

Rural forest: There are about 2 lac 70 thousand hectares of lands in Bangladesh that belong to the rural forest. People create this forest near the house- holds, ponds, rivers and other water bodies.

Task : The work of the following table will present in the posters in groups

Name of forest	Situation	Remarkable plants	Animals inhabited
1. Hilly forest			
2. Plain land forest			
3. Mangrove forest			

Amount of wood stored in the forest land

The amount of wood stored in the different forests of Bangladesh is determined by survey and report. The amount of wood stored in the forest is called growing stock. The forest management plan is prepared based on amount of this growing stock. The amount of wood obtained from the report on the different forest lands are presented in the following table:

Amount of wood stored in the forest

Types of forest	Amount of stored wood million* cubic meter
Hilly forest	20.71
Mangrove forest	12.32
Plain land forest	1.20
Rural forest forest	54.68
Total	88.91

* Million = 10 lac

Social forest

People are directly involved in the management of social forest. The afforestation program which is executed for social welfare through willingly participation of the people is called social afforestation.

The forest department of Bangladesh, in the mean time, has taken effort to grow mangrove forest in the coastal char areas. Besides, the government of Bangladesh has taken plan for social afforestation from the beginning. The people are being participating directly in this program and are getting benefit. At present, the social afforestation has introduced near almost all roads, highways and rail lines of Bangladesh. The co- operative base programs are being executed regarding tree plantation and their maintenance. The social forest has established mainly in the high and medium high land.

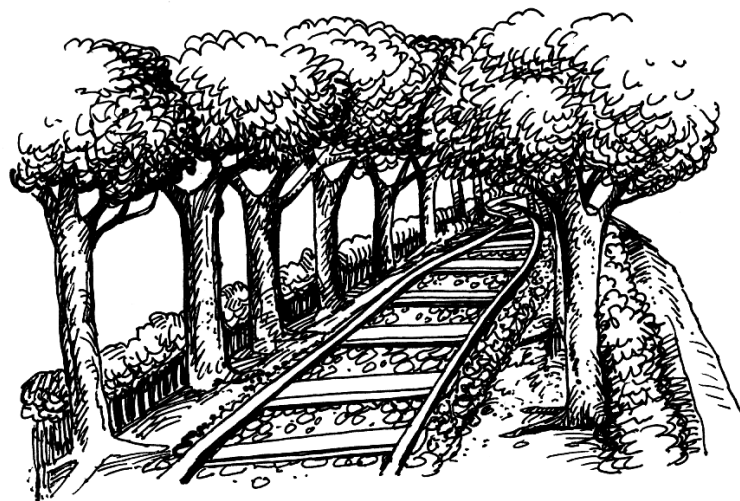


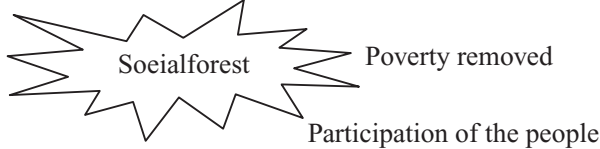
Fig: Social afforestation

Necessity of social afforestation:

1. To supply wood for house- hold construction and furniture, and to fulfill the lacking of fuel wood.
2. For afforesting in fallow lands, house- holds, road, railways, bunds, banks of canals, bills and rivers and various organizations and to conserve environment.
3. To engage the poor in works and to remove poverty.
4. To create forest for feed, vegetables, fruits, herbal and recreation.
5. To supply forest produced raw materials to rural small cottage industries and create employment for people.
6. To maintain natural balance, to prevent environmental from pollution and desertification.
7. To fulfill the basic demand of the people.

Task: Group task

Prepare a map of necessity of social afforestation on poster paper.


Types of forest area and characteristics: Agricultural forests

The agricultural forests are being extended in the world to save environment, supply fuel, increase supply of wood and raw materials of industries. At present, the sufficient improvement in agro-forestry systems is also being improved in our country. Agro- forestry means the production systems of different trees, crops and livestock- poultry from a single land at a time or in rotation. In general, agro- forestry is a kind of integrated land management system. In this system, measures are taken to grow perennial woody plants along with the production of agricultural crops, livestock, fish and other agricultural systems.

Characteristics of agro- forestry

1. Measures can be taken for more production by using the same land repeatedly.
2. Production risk becomes lower as there is a combination of diversified plants and crops.
3. The farm production becomes sustainable thereby employment opportunity is increased.
4. Social and environmental acceptability is increased.
5. Marginal land resources are used.
6. There is an opportunity to use local inputs.

7. The demands of the owners of crop farm, mixed farm and forest garden are filled up.
8. The products of Agricultural forest can be sold in the local market.

Agro- forestry: Methods and types

1. Crop forest: It is a combination of different trees in different location with inters crops. The main objective is to produce food and feed.
2. Pasture forest: It is a mixed farm. The main objective is to produce food and feed.
3. Agro- pastures forest: Dual cultivation of crops. Sometimes forest trees can be grown.
4. Agro- forest and fish farm: It is possible to have mixed farming. It is to be established farm in combination of high and low lands. Crop plants and fish can be produced.

The necessity of agro- forestry

1. To increase the agricultural production.
2. To fulfill the food demand and acquire foreign currency.
3. To lesser the production risk by multiple use of arable land.
4. To provide employment opportunity for large population and to eliminate poverty.
5. To bring economic solvency in rural human life by making local agricultural market.
6. To use improved agricultural technologies.
7. To encourage improvement based on the results of agricultural research.
8. To increase soil fertility and to control soil erosion.
9. To produce feed and make secured residence for animal, poultry and beneficial insects.
10. To keep environmental balance and to protect from natural hazards.

Task : The learners will cite two characters of forest individually.

Section-2

Forest Conservation Act

Forest resource consists of the vines- shrubs, trees and wild animals. This forest resource is an important resource of a country. There is a rigorous relationship among these plants and wild animals. If one of these is affected somehow, the others are automatically destroyed. There are specific policies or rules about new forestation or tree cutting, exclusion, transportation etc. from the public frosts. These policies or rules are called forest policy or forest act. For conservation and management of all forest resources, there established forest conservation act in 1927 in this sub-continent which is known as "Act, 1927". Thereafter, the Government of Bangladesh brought some amendments of this act in 1990 which is known as " Forest Act (amendment), 1990". After establishing this act, the tendency of injudicious

deforestation becomes lower but complete protection is not yet possible. Therefore, it became necessary to make this act of 1990 time demanding. Consequently, there brought some more amendments of this act in 1996. With the power of this act, there has been exerted some rules and regulations to conserve forest resource. There is a decree of punishment for breaking these rules and regulations.

Besides, the Government of Bangladesh, which can do more with the power of forest law are as follows-

1. can decide to establish forest in a forest land by gazette notification.
2. according to this gazette, the affected person or other proprietor can present the details of impairment on presence with written document in front of forest officer within at least three months and maximum four months.
3. A forest or some parts of it is conserved, protected, in such manner, the government can give order by similar gazette notification.

Description of Forest Act

Let us now learn the remarkable aspects of traditional Forest Conservation Act. According to this act, the following activities will be considered as punishment-

1. The trees and other forest resources cannot be taken from public forest lands without appropriate permission.
2. The transfer of wood or other forest resources collected from semi-governmental or local governmental or autonomous or personal land to any places of own district without permission.
3. Entrance into the public forest, damaging the forest land by making residence and cultivating it without appropriate permission.
4. Grazing livestock inside the forest area.
5. Tree felling, removal and transportation without necessary permission.
6. Making fire, keeping or carrying fire without permission by the appropriate authority.
7. Damaging the forest during wood felling or its removal due to insincerity, tree felling, boring, bark removal, leaf plucking, burning or damaging trees by other means.
8. Hunting in the forest, shooting, fishing, making water toxic or trapping in the forest.
9. Removing, transporting or handing over of forest products without permission of the authority.
10. Hampering the duties of the forest officer or of the person engaged in the maintenance of forest.
11. Making holes, burning lime or wood and coal inside the forest or collecting forest products except wood or processing and removal of industrial products without appropriate permission.

12. Entering into any restricted forest with firearm without previous permission of the divisional forest officer.

Punishment for contravention of Forest Act

There are various laws of punishment for contravention of Forest Act. There is a law of fine of taka five thousand with minimum six months' jail or of fine taka fifty thousand with maximum five years' jail due to contravention of the above laws. The judgments of these blunders are performed in the court of first class magistrate.

Wild animal conservation act

For conservation of wild animals, the government of Bangladesh established a law in 1973 which is known as Wild Animal (conservation), Ordinance, 1973. In this law, there are some rules and regulations that imposed on hunting or killing wild animals by any means, hampering reproduction of wild animals, hunting any animal within one mile of the national park, importing foreign animals or exporting etc. without permission. The contravention of these rules is punishable mistake. The person who breaks the forest animal conservation act will have to be punished as fine of taka five hundred with minimum six months' jail or of fine taka two thousand with maximum two years' jail. There is a law of monetary fine with jail for different durations for those who violate this law. But some cases, such as to save human life, to protect crops from damage etc., hunting or killing of wild animals is not punishable blunder.

Task: Discuss with Forest Act and Wild Animal Conservation Act in group. Present the poster in the class preparing on this aspect.

Necessity of Forest Conservation Act

Now it is the demand of time to increase forest of the country by conserving the existing forests of the country and by creating new forests. Because forest can maintain the environmental balance. But the population density in our country is very high. This higher population is creating a large pressure on the limited forest resources to meet up their basic needs. Men are destroying forest trees and a wild animal to meet up daily's demand. The dwellings of wild animals is being damaged, breeding is being hampered and caused due to the destruction of forests. The wild animals are also being destroying by illegal hunter. Illegal entrance in the forest is increasing. The forest resources are being stolen and got away. One kind of dishonest people are destroying forests. The residents nearer to the forests are grasping forests. The illegal residence are being constructed in the forest areas. The dishonest cycle is destroying hills by cutting hills and removing woods. Besides, the trees of created social forest are grasping. Consequently, the different types of natural calamities are increasing including soil erosion, land slide. The country is facing problems regarding its environment and economy. To save forest resources from destruction the Forest Conservation Act has been established. For effective application of this act, the government has to be taken appropriate steps. Public relation has to be increased in view of increasing population vigilance about Forest Act. On execution of Forest Conservation Act and Wild Animal Conservation Act, a lot of benefits can be achieved.

Section-3

Forest Nursery

Forest nursery

According to dictionary, forest nursery means the accommodation of seedlings. Nursery is a place where seedlings are taken care and maintained until their transportation and planting. It is possible to obtain healthy, strong and nice seedlings from an ideal nursery adopting modern technique. Seedlings are produced from seed in the nursery. Furthermore, high quality seedlings are also produced from cutting by modern technique.

Necessity of nursery

There are some seeds that have to be planted within 24 hours of shattering from the plants. Otherwise the rate of germination becomes to decrease. For these species, nursery is essential. For example, the seeds of garjan, sal, rubber, telsur etc. have to be planted within 24 hours. The healthy and strong seedlings are necessary to build a quality garden. These types of seedlings can be prepared in the nursery. Besides, some other reasons for which nursery is essential are-

1. timely availability of improved healthy and larger seedlings.
2. facilitates marketing and distribution of seedlings having different ages.
3. facilitates cultural operations of many seedlings at a time.
4. seedlings can be produced at low labor and low cost.
5. many seedlings can be produced at lower expenditure.

Contribution of nursery perspective of socio- economic condition

1. Producing seedlings of forest, fruits and medicinal plants in the nursery are produced and sold to public. Consequently, it increases tree plantation.
2. Many people live by nursery.
3. Many people get economic benefit by nursery business.
4. The public and private forestry are established with the seedlings produced in the nursery.
5. The seedlings produced in the nursery are used to build coastal green prevaricate.

Types of forest nursery

Types of nursery: There are different types of nurseries, such as- 1. Nursery based on the media 2. Nursery based on the longevity 3. Nursery based on the economy 4. Nusery based on the uses.

1. Nursery based media

Nurseries, based on the media are again of two types.

a. Poly-bag nursery

In this type of nursery, seedlings are raised in polythene bags. The seedlings can be saved from drought, rainfall and calamity as poly-bags can be removed easily. The disease infection from one plant to the other is lower. In this method, seedlings are taken care intensively.

b. Bed nursery

In this method of nursery preparation, seedlings are raised directly making beds in soil. A number of seedlings can be raised in small areas at a time in this nursery. Consequently loss of seed is lower. The production of fast growing seedlings is good. The production of seedlings from cuttings and rhizomes become easy. The bed soil used for raising seedlings is to be fertile.

2. Nursery based the longevity

Nurseries, based on the longevity are of two types, such as-

a. Permanent nursery: In this type of nursery, there is a scope for raising seedlings for year after year. The facility of permanent nursery is that the proper place for nursery can be selected. Green house and seed storage can be constructed but it requires high capital. Seedling transportation cost becomes higher.

b. Temporary nursery: In this nursery preparation, seedlings are raised according to their demands. The problem is that the conservation of this nursery is difficult.

3. Nursery based on the economy

Nurseries, based on the economy are of two types, such as-

a. Home nursery: The seedlings of flower, fruit and woody plants are raised according to family need.

b. Commercial nursery: In this nursery, the seedlings of fruits, vegetables, woody and medicinal plants are raised in view of commercial use and they are sold and supplied.

4. Nursery based on uses

Task: The learners will prepare a list of tree by visiting forest nursery in groups.

These types of nursery are made based on the uses of plants. For example, the nursery made for raising seedlings of for mehogoni, segun, rain tree.

Forest nursery seed

Collection and storing of forest nursery seed

Seed is the main reproductive input of plants. To get good seedlings, good seed is required. For that reason, seed will have to be collected from mother plant having definite quality. The collected seed will have to be stored properly for the duration

started from seed collection till sowing. The seed can be infected by insects and mites, fungus and bacteria etc. if they are not stored properly. Consequently seed quality is deteriorated. Germination capacity is decreased. Besides, the seed quality will have to be determined by testing them in various methods. Seed should be marketed and distributed after processing properly. In this chapter, we shall learn about selection, seed collection methods, seed storing methods, seed testing and processing techniques before sowing.

Selection of mother plant: Middle aged, healthy, strong, disease free and high yielding plants should be selected. Seeds should be collected from these selected plants at proper time. In our country, seeds are collected from seed mother plants selected from one or more sources, such as-

1. Farmers' houses of own or other areas.
2. Park or garden areas or forest regions.
3. Road side trees.
4. Seed collection is essential from different permanent nurseries, high quality seed mother plant etc.

Methods of seed collection

Generally seeds can be collected from plants by two ways.

1. **Seed collection from land:** Some seeds when shattered down to soil become suitable for seed collection. These seeds are to be collected middle period of seed maturity. The fruits of those plants which are not split after ripening, seeds from these plants are collected in this method. Seeds of segun, garjan, sal, kadam, pitraj telsur etc. can be collected from soil.
2. **Fruit and seed collection plant:** In this method, the branches are cut with hashua or knife from the plants when fruits are matured and seeds are collected. The small seeds which falling on soil spread away, are collected in this method, such as-
 - a) Pod- babla, karoi etc.
 - b) Capsule- mehgoni, champa
 - c) Cone- pine.

After collecting fruits and seeds from the plants, they should be dried in the sun. Thereafter seeds should be collected by cracking pods, capsules or cones.



Fig: Mehgani capsule

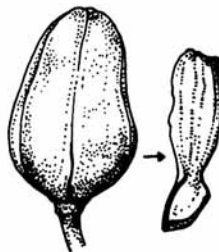


Fig: Pod of karai



Fig: Pine cone

Seed separation: After collecting fruits, the removal of seeds from husk, residues, seed coat etc. is known as seed separation. The three main methods of seed separation are-

1. **Selection method:** The selection method is used for those plant seeds which require shorter duration i.e., 4- 7 days for seed germination. The entire seed is used as seed in these plants. For example, germination capacity of coconut, garjan, Shal, segun seeds is increased when dried in the sun.
2. **Dry method:** Seeds of zarul, cotton, ipil-ipil, mengium, babla, mehgoni, karo are separated by dry method. The fruits are dried well in the sun after collecting from the plants. When seeds are come out on splitting fruits, then seed are collected by threshing.
3. **Decomposition method:** In this method, fruits are allowed to decompose in water and after decomposition, seeds are collected from fruits. For example, mango, jackfruit, tamarind, guava etc; thereafter seeds should be dried in the sun.

Seed Preservation:

The seeds are preserved after harvesting to till next sowing. The quality of seeds becomes deteriorated if they are not preserved in proper method. Consequently quality becomes deteriorated. For example, on preserving, the seed germination capacity of garjan, Shal, segun, chapalish, telshur etc. plants is decreased. The seeds of these plants must be sown within 24 hours. It is better to store seeds in thin layer. The seeds are to be kept dry always. The seeds should be kept in comparatively cool and dry places. The seeds are kept open without controlling temperature and humidity. The seeds are preserved at normal temperature and in refrigerator maintaining humidity.

Task : The learners will present methods of seed collection and seed preserving orally.

Techniques of preparing forest nursery

Preparation of permanent and temporary nursery, both require proper planning and some rules.

Permanent nursery

The permanent nursery is established to raise seedlings commercially. Forest department, horticulture, BADC field, private nursery centers are permanent nursery. The considerations for establishing a permanent nursery are-

1. **Selection of site:** The land should be of well shiny, aerated, open and high. The selected land should be such that there is no rain water and water stagnancy and have fertile sandy loam or loamy soil. The location should have improved communication and proper water management systems. It should have adequate lands and labour availability.

2. Determining the land area.

Determination of area for one square meter seed bed or pot bed

Size of poly bag	Number of seedling per square metre
15 cm× 10 cm	65
18 cm× 12 cm	45
25 cm× 15 cm	26
Distance from seedling to seedling in the seed bed	Number of seedling per square metre
5 cm× 5 cm	400
18 cm× 12 cm	200
25 cm× 15 cm	100

3. Fence preparation:

It is necessary to make fence to protect seedlings from injurious animals and passengers. The ways of making fence in the permanent nursery-

- a) **Bricks wall:** The fence can be prepared by constructing high bricks wall around the permanent nursery.
- b) **Barbed wire fence:** Barbed wire fences can be easily be set up around the nursery.
- c) **Iron wire net fence:** Fence can be made by iron net tied with pillars and living plants can be planted beside the net. Three types of pillars are used at 2 metre intervals like barbed wire fence.
- d) **Fence by living plants:** Permanent fence can be prepared around the nursery with duranta, kanta mehedi, mehedi, djoal kalmi etc. living plants.

4. Land development

Land developmental works are to be started just after selecting site for nursery. The place for the hedge is to be cleaned well. To avoid stagnancy of rain or irrigation water, the land should be slightly sloped and a drain should be made. The soil should be of loamy or sandy- loam.

5. Office and residential area

The nursery office building should be situated near the entrance beside the main road. The office and residential areas should be outside the area of seedling production. It is not ought to keep residence inside the nursery.

6. Electrification

It is good to have electricity facilities inside the permanent nursery. Thus nursery maintenance becomes easier.

7. Road and street

It is essential to have a main road to enter into the nursery. The main road should be connected with the streets inside the nursery in plan way.

8. Irrigation system

Nursery requires water for raising seedlings. For that reason, good irrigation system should be ensured at the beginning of the nursery establishment.

9. Canal and drain

Drainage system must be ensured in the nursery. For that reason, it is necessary to keep necessary drains and side drains. They should be of concrete made in permanent nursery. They should be kept clean regularly.

10. Nursery block

The place of raising seedlings in the nursery will have to divide into some blocks. Each block is to be divided into some seed beds or pot beds. Ten to twelve beds may remain in each block. Green housed shed, compost pit, place of keeping soil etc. should also be distributed to block.

11. Nursery bed

Bed may be generally of two types-

a) Bed for raising seedlings by direct seed sowing: For that seed bed, land should be cleaned well. Soil should be loose by spade or plough. The land is to be prepared by cleaning all types of weeds and gravels and ploughing well. Thereafter, based on the place, beds measuring 1m×3m×20cm are to be made. After making beds, necessary cowdung or compost and chemical fertilizer should be mixed; after some days the seeds should be sown.

b) Bed for raising seedlings in poly bag: In this case, ploughing is not necessary. Only beds should be leveled by lifting soil upto 10- 15 cm between two beds. Thereafter the edges of beds are prepared. But depending on the necessity of nursery, bed size may be small or big.

Task: Learners will visit any forest nursery nearby to the school. They will prepare a list of tree seedlings present in the nursery and will submit to the teacher in group.

Section-4

Tree Felling and Wood Collection

Tree is our very valuable national resource. Though it is necessary to plant tree for economic need, for the same reason tree felling may be necessary. Generally tree felling is performed after the completion of plant's life cycle. But there is an exception for those plants which are used for beautification and environmental conservation. Tree felling and wood collection are very important aspect. For this

purpose, it is necessary to know various methodologies. After cutting plant, if it is not used as pillar, it should be sawn and should be assembled wood of necessary amount. Thereafter seasoning is necessary to increase the longevity of wood. Proper processing is also necessary to increase the longevity of bamboo. In this condition, by seasoning wood or bamboo, their quality and longevity can be increased.

In this chapter, we shall get idea and acquire efficiency about time and rules of tree felling, methods of wood preservation, measurement of log, necessity of tree felling and wood collection.

Time of tree felling or time of rotation

The duration from seedling plantation to maximum growth of the tree when it attains maturity and becomes usable is called time tree felling. Tree felling before maturity does not produce good quality wood. In forest management, the time of tree felling is divided into three categories, such as-

1. Short time of rotation: The plants whose wood is soft and fast growing, used in producing fuel wood, livestock feed and pulp, their time of felling is short. Generally, these trees are cut at 10- 20 years of rotation. For example, Akasmoni, Shimul, Telikadam, Kaora, Bain, Babla, Jhao, Ipil-ipil etc.

2. Medium time of rotation: The plant species which produce partially hard wood and are used to prepare pillars or wood belong to this time rotation. They are cut in 20- 30 years of rotation. For example, Gamar, Shishu, Mango, Karao, Khayer, Bakul, Haritoki, Chhatian, Chandan, Rendi karai or Rain tree etc.

3. Long time of rotation: The slow growing plant species producing hard wood are used to prepare only wood are cut in 40- 50 year of rotation. For example, Segun, Garjan, Sal, Jarul, Shilkarai, Mehgoni, Telsur, Chapalis, Jackfruit, blackberry etc.

Rules for tree felling:

1. The tree may be cut at near the soil level as close as possible. Because the base of the tree is always more thick and have more quality wood. Cutting of tree at 10 cm above the soil can produce maximum quality of wood.
2. Before felling, the branches of the tree should be cleaned. Thus the felling of tree can be controlled.
3. The tree should always be cut with saw. Thus, the loss of wood can completely be controlled. At first the direction towards which the tree has to be felled, cutting with saw should be on that side. A wedge should be inserted in the cut part and thereafter cutting should be performed at the opposite side. Consequently the tree will be felled at the desired side.
4. The cut tree after felling on the soil should be cut into pieces. But the measurement will depend on the uses of the wood. The round piece is called log. The log is brought to the saw mill and be made usable by sawing. The sawn wood has length, breadth and thickness. The sawn wood having length more than 15 cm and thickness 4 cm is called wood sheets or takta.

5. At first the two- third portion of the tree should be cut 10 cm above the soil toward direction of felling tree. Thereafter, cutting should be 10 cm just above this cut. Cutting trees this way tree is possible at the desired side. Consequently nearby trees are less affected. It is very easy to cut trees using an axe/saw or both.

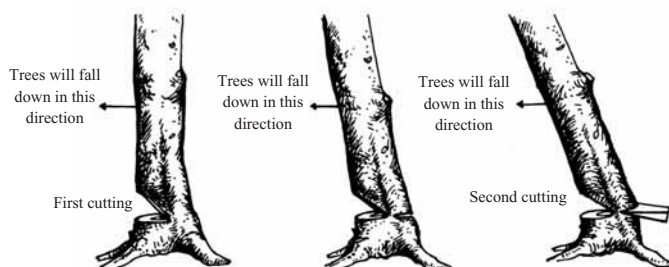


Fig: Method of felling tress

Methods of measurement of timber log and sawn wood:

The correct volume of logs may be determined with the help of Newton's Law.

The formula is:

$$\text{Volume} = 0.08 \times \frac{C_1 + (4 \times C_2) + C_3}{6} \times \text{Length}$$

Where C_1 = Circumference of the narrow end

C_2 = Circumference of the middle place

C_3 = Circumference of the broad end

Example : The Length of a Garjan Log is 6 metre. It's circumference of the narrow end is 150 cm, at the middle 2.0 metre and at the broad end 2.5 metre. What is the actual volume of the log.

Solution:

$$\begin{aligned} \text{Volume} &= 0.08 \times \frac{C_1 + (4 \times C_2) + C_3}{6} \times \text{Length} \\ &= 0.08 \times \frac{1.5 + (4 \times 2) + 2.5}{6} \times 6 \text{ cubic metre} \\ &= 0.08 \times \frac{12}{6} \times 6 \text{ cubic metre} \end{aligned}$$

Volume = 0.96 cubic metre

Measurement of Usable Wood

A portion of the Log wood is always lost in the process of sawing. All the woods can not be made usable. How much usable wood will be available from a log may be calculated by a formula, according to the Hompus Law. The formula is given below:

$$\text{Volume} = \left\{ \frac{\text{Middle circumference of log}}{4} \right\} 2 \times \text{Length}$$

Measurement of wood volume of wood sheets is very easy. If the length, width and thickness of the wood is known, then the volume may be easily calculated. The length, width and thickness of wood may be measured by a measuring metre scale. Then the volume may be calculated on the basis of formula given below.

Volume = Length x Width x Thickness

If the length, width and thickness is measured in metre the unit of volume will be cubic metre.

Wood seasoning and treatment

Though water is essential for plant in living state after cutting the lower the moisture content the higher will be the longevity of wood. Lowering the moisture content of wood to 12% of its weight the wood quality seems to be good. Ghoon, insects or fungus cannot attack easily. The removal of water from wood by a controlled method to ensure higher longevity is called seasoning. Seasoning may be done by two ways.

1. Air drying

Drying of wood after sawing in open air is known as air drying. But very thinly sliced woods may show fracture or may be curved when left under strong sun in open air. That's why these types of woods are kept in shade 30-40 cm above the ground in layers. The wood layers are arranged such a way that aeration is ensured surrounding every wood piece. The wood pieces cannot be left in a disarranged manner, which may result in curving of the wood. Air drying process of wood treatment requires at least one season and moisture content remains near to 12%.

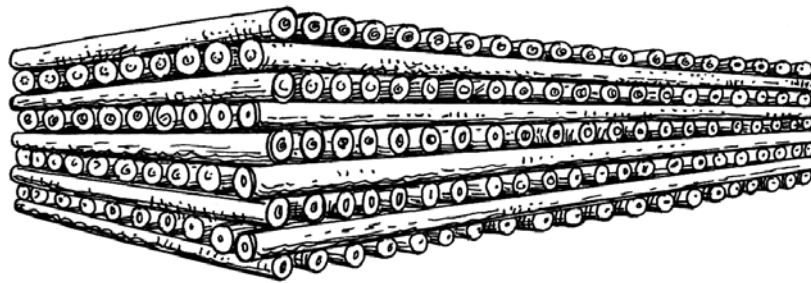


Fig : Air drying

2. Kiln drying

Generally Kiln method or drying is used to dry large amount of wood at a time. In Kiln method, air can move between two wood sheets and the wood sheets are kept in a large air- tight room. To do this, 3- 4 cm thickened two pieces of wood are inserted at the two sides between two wood sheets so that air can move between the wood sheets. Thereafter, at first the moisture content of wood is to be increased by inserting water vapor in the air- tight room. Then the water from the wood is to be drained out by at the same time applying heat. In this method, Wood seasoning by this process requires three weeks and moisture content lowered to 12%. But duration of seasoning may vary with the species.

Wood preservation

The principle of wood treatment is to insert chemical substances into wood and bamboo in solution form. A chemical namely CCA is widely used in our country as preservative. The CCA preservative is composed of 3 ingredients. The CCA mixture of chromic oxide 47.5%, copper oxide 18.5%, arsenic penta oxide 34.0% is available in market. The preservatives may be prepared by purchasing these chemicals separately and mixing in rightly measured quantities. Then 2.5% solution of the preservative is made by mixing with water. The solution is pushed into wood and bamboo by a special mechanical arrangement of giving high pressure. It is recommended to push 0.4 pound of preservative into one cubic foot of wood. In this method wood becomes ready for use after 7 days of treatment. Using CCA preservative may prevent the rotting of stored woods. Besides, this chemical can also prevent attacks of termites.

Necessity of preserving tree felling

There are various objectives behind planting tree and allow them to grow by taking care. But whatever the objective, it is better to have felling tree after the completion of specific time rotation and at proper maturity. Because exceeding specific time the quality may be deteriorated. Besides, sometimes the bark may be cracked and become diseased which may affect inside the stem. The time of felling tree depends on several aspects, such as-

1. What will be done by wood?
2. Of which measurement wood is necessary?
3. What quality wood is necessary?
4. Either instant money is required or not?
5. On allowing further growth of plant, either the surrounding area may be covered by branches or not?
6. The tree either may be injurious for buildings or living beings due to felling by cyclone or not?
7. Either the plant attacked by special disease or not?
8. Either the time of tree may be completed or not?

For what purpose the tree is cut it should be cut following proper rules. By cutting and making piece properly, loss of wood may be controlled. Furthermore, by adopting scientific preservation technique before use, their longevity may be increased. It is necessary to adopt some rules during collecting tree resourcen a forestrea, the collected wood per year should be less than the increase of wood. Consequently the forest resources will be conserved.

Task: Learners will measure the amount of log or wood sheet and submit a writing on treatment methods in group

Section-5

Coastal Afforestation

Concept of coastal afforestation

The natural forest conservation and afforestation in the coastal regions of Bangladesh has been reached at danger due to salinity and repeated natural calamities. The environmental balance of these coastal regions influences environmental balance of the entire country. For this reason, making coastal green prevaricate by cultivating salinity tolerant crops and planting trees tolerant to salinity, tidal surge and cyclone in the coastal areas is essential. If it is possible to execute this plan, besides escaping human, livestock and natural resources from natural calamities the coastal inhabitants can also be economically benefitted.

Characteristics of trees used for coastal afforestation (Jhao and debdaru)

The coastal forest areas are also called saline soil areas. Saline soil regions include the coastal areas of Bagerhat, Khulna, Satkhira, Patuakhali, Barguna, Bhola, Barisal and surroundings char regions. The main tree species of these regions are- coconut, hogplum, date, babla, cashew nut, shirish, rain tree, plum, tamarind, betel nut, olive etc. But jaho and debdaru plants are also remarkable as coastal plants. These plants have desert characteristics, therefore they can adapt to coastal regions by tolerating salinity. Sudry, gaoa, kaoa, kakra, bain, garan, golpata etc. plants grow well in highly saline soils of coastal regions. These plants have some special characteristics to adapt salinity.

1. The plants selected for coastal regions should have extensive root system. For this reason, coconut, betel nut or other monocotyledonous plants should be more in coastal regions. Since the extent of roots of these plants is larger, the soil erosion control becomes easier. But in case of afforestation in coastal barrage, tree should be planted in more than one row like that of roads.
2. The location in which tree are planted in coastal barrage is highly sloped. For this reason, trees are planted in rows. The tree should be planted in alternate arrangement in rows. Actually though the trees are planted maintaining wider distance, the distance between trees is maintained $2\text{m} \times 1\text{m}$. Consequently, the efficiency of soil erosion is increased.
3. The coastal plants have desert characteristics, such as thick cuticles on leaf. For this reason, these plants are of drought tolerant.
4. They can survive by facing hazards like cyclone etc. Because, their stems are very tall and hard and they have less number of branches. For example, coconut, gajari, date, plum, jhao, akashmoni, babla, debdaru etc.

5. The coastal barrages are used as shelter of cattle and goats during calamities. Therefore, fodder crops are also planted there. For example, ipil- ipil, akashmoni, dhaincah etc.
6. The plants which can tolerate submergence and salinity should be planted for coastal afforestation.
7. The plants having hard and tall stem; small leaves and can tolerate debranching can be selected for coastal afforestation. For example, shishu, babla, karoi, date, plum etc plants.

Jhao plant

Description: Jhao is a large sized ever green tree. The height is around 15- 18 meter. The bark is brown and glabrous. Wood is very hard but becomes cracked. It flowers in May and ripening of fruits requires one year. Sandy soil is very effective for afforestation with jhao plants.

Existence: Mainly coastal regions but it may be found in the different locations of the country.

Seed: seeds are collected in the month of May- June.

Uprooting seedlings: Seedlings of jhao are uprooted in the month of February.

Methods of seed collection: Fruits are to be collected directly from the plants. Collection of fruits from the base of the branches is the best as they are matured. The seeds are separated from the husk by stick after drying for 2- 3 days.

Seed Preservation: Seeds can be stored for 5- 7 months in air- tight pot after drying in the sun.

Methods of seed sowing:

Seeds are sown in the seed bed or poly bag in January- February. Sowing seeds in the seed bed or poly bag mixing with treated soil is beneficial. Seed germination requires 25- 30 days. Measures should be taken for shade before seedling emergence. The shade should be removed after 40- 50 days.

Seedling selection and planting:

Some seedlings are to be removed whenever they found higher number in the seed bed. Weeds are to be removed. If the roots of seedlings come out of poly bag, roots should be cut. Jhao is a fast growing plant. It is better to plant seedlings of age 6 months. Jhao plant grows well in sandy and saline soil. For this reason, jhao tree is planted during afforestation in the coastal regions.

Uses: It is planted beside the roads and highways for beautification as it is of triangular shaped. Since it has nitrogen adding capacity in soil, it is planted more in than coastal regions. Wood is very well as fuel. Wood is very hard; so it is used as pillar or fuel.

Debdaru

Description: Debdaru is evergreen tree; stem is thick, straight and very high. Generally, it is planted for beautification. The plant is of 50- 60 in height and it can survive up to 500- 600 years. Leaves are dark green, compound, looks almost like a dart but their edges are wavy. Generally it flowers in October, thereafter bears fruits. Ripening of fruits requires more time. This plant is found all over the regions of Bangladesh.

Time of seed collection: July- August.

Methods of seed collection: The ripened fruits are black in color. After ripening fruits, they are collected from the plants or under the plants and kept in the sac. The sacs are kept in water; after rotting of fruits, seeds are collected. The debdaru seeds should be sown just after collecting as they cannot be stored.

Methods of seed sowing: Two seeds are sown in each poly bag. Initially they require shade. The seed germination capacity is 90%. Seeds are germinated within 7- 15 days.

Seedling age during planting: It is better to plant seedlings of age one and half to two years beside the roads, garden and coastal regions in the month of July.

Uses: The debdaru wood is light and soft. Debdaru wood is used to prepare tin edge frame, pataton, matches and packing box. Debdaru wood is also used to prepare paper pulp.

Necessity of coastal afforestation

Through coastal afforestation, if green prevaricate may be prepared and conserved, we can get various benefits. Conservation of coastal environment means fertility increase and protect the coastal regions from cyclone and tornado. The coastal afforestation and its conservation are essential to fulfill the demand of fuel and food, earn money, protect soil erosion etc. The necessities of coastal afforestation can analyzed from the various points of view as follows:

a) Environmental necessity

1. Trees of this forest area control soil erosion of coastal regions, increase soil fertility and increase ground water table.
2. Help to make the environment suitable for living by decreasing salinity of soil.
3. Keep the balance of oxygen and carbon dioxide in the environment, protect creation of heat and make the air refresh.
4. The coastal green prevaricate escape the men and other organisms from coastal storm, tidal surge and cyclone.
5. It controls land slide, sand storm and cyclone and helps in rainfall.

6. This forest area makes sanctuary of men, birds, animals and insects- mites and protects them. It also supplies food. Thus maintains environmental balance in this area.
7. The coastal afforestation plays an important role to protect our valuable natural resource, the sundarbans, and its animals from natural calamities. To protect the world famous mangrove, the sundarbans, there is no alternative of creating coastal green prevaricate.

b) Necessity of pleasure

The green prevaricate made by coastal afforestation creates a beauty full of pleasure. This beauty attracts many tourists of home and abroad. It creates sanctuary of various birds and animals which is very beneficial for the environment and also adds new pleasure.

c) Economic necessity

1. The economic necessities of trees of coastal forest areas are boundless. This forest extends the earning ways from the tourists of home and abroad. Consequently, it brings the national economic solvency.
2. The crop produced from fruit trees like coconut, date, plum, banana, mango etc. meet up the food demand and brings economic development.
3. It is possible to earn money from honey and wax produced in the forest areas. Food, vegetables, poultry feed and animal feed are obtained from flowers, fruits and branches.
4. Fuel wood, pillars, furniture, house-holds, vehicles, agricultural inputs, railway slipper etc. are obtained from stem and branches of trees.

Task: The learners will prepare a report in groups analyzing the necessity of coastal afforestation.

Exercise

Short Answer Questions

1. Which plants and animals are found in hill forest?
2. What is Forest Act?
3. What is meant by forest nursery?
4. How is the plant to be cut to control wood loss completely?

Descriptive Questions

1. Describe the extent of forest area of Bangladesh with map.
2. Describe the necessity of Forest Conservation Act.
3. Describe the methods of measuring log wood and sawn wood.
4. Describe the ways of seasoning and treatment of bamboo and wood.

Multiple Choice Questions

1. The amount of hill forest-
 - a. 12.16 lac hectare
 - b. 13.16 lac hectare
 - c. 14.16 lac hectare
 - d. 15.16 lac hectare
2. Which one of following trees is of shrub forest area-
 - a. Garjan, garan, gamar
 - b. Gajari, gaoa, segun
 - c. Telsur, champa, chapalika
 - d. Jarul, rain tree, pashur
3. Most of the forest land of Bangladesh is situated in-
 - i. South- eastern region
 - ii. South- western region
 - iii. North- western region

Which one of the followings is correct?

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

Read the following paragraph and answer to the question number 5 and 6:

Tia was watching a program on forest in a television channel. Once she found germination of most of the plants of that forest is being occurred when remained in the fruits and after emergence the seedlings is falling and inserting in to the clay.

5. In which plant the germination found by Tia is occurred?
 - a. Garan
 - b. Gamar
 - c. Garjan
 - d. Gajari

6. The character of the forest found by Tia is-

- i. Soil is muddy
- ii. Aerobic root present
- iii. Branch root is long

Which one of the followings is correct?

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

Creative Questions

1. Mr. Zaman sown seeds of mengium in 4 hectare high land on the pond bank in the southern part of his households in accordance with the suggestion of agriculture officer. For this reason he used poly bags of measuring 15 cm×10 cm. Consequently Mr. Zaman became highly successful.
 - a. What is called nursery?
 - b. Explain a necessity of nursery establishment.
 - c. Calculate number of seedlings of the nursery of Mr. Zaman.
 - d. Analyze the cause behind the success of Mr. Zaman.
2. Sufia Begum cut two mehgoni trees which were planted 20 years ago to use in house hold during its construction. The laborers used axes during cutting the two trees. The length of logs of the two plants were 8 meter, circumference of the narrow end was 2 metre, circumference of middle end 2.5 metre and circumference of the broad end was 3 meter.
 - a. What is wood seasoning?
 - b. Based on time rotation, what types of plants are gamar and shishu? – explain.
 - c. Measure the volume of a plant of Sufia Begum.
 - d. Analyse the program of Sufia Begum either it was correct or not.

Chapter-Six

Agricultural Co-operatives

Doing any work in a group to achieve similar objectives is called co- operative. For necessary capital collection the members of the co-operatives can perform agricultural works, agricultural mechanization, crop production, crop harvesting, post- harvest operations, storing, transportation and marketing to be completed smoothly by the members of the co-operative the limited numbers of farmers can get united and with their common conscious to form an agricultural co-operative. Co-operative is an occupational organization of farmers own. The state accepts and helps this type of organization. If this type of co-operative is formed in accordance with the traditional co-operative law of the country it can get registration under co-operative law. We shall discuss agricultural co-operatives in this part.

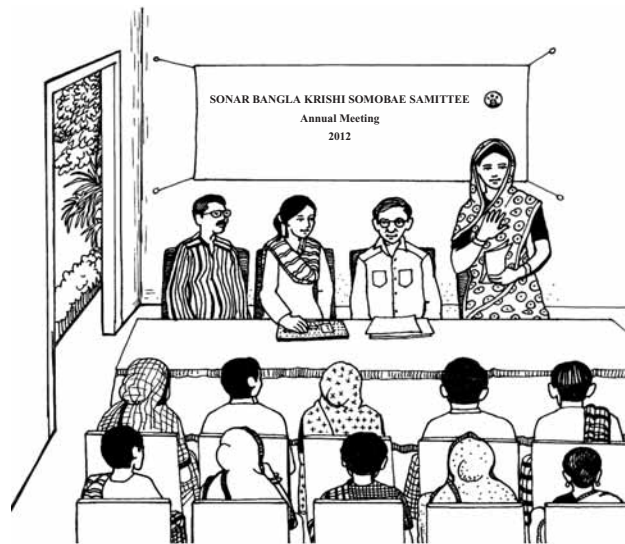


Fig: Co-operative office

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

- ☐ • ☐ can explain the concept of agricultural co-operation.
- ☐ • ☐ can analyze the importance of agricultural co-operation.
- ☐ • ☐ can explain the collection and uses of agricultural inputs through agricultural co-operation.
- ☐ • ☐ can explain the production, storing and marketing of agricultural products based on the agricultural co- operative.
- ☐ • ☐ can analyze the necessity of agricultural co- operative in the production, preserving and marketing of agricultural products.

Section-1

Concept of Agricultural Co-operatives and Importance

To understand the subject, it can be started with game. Let, boys or girls in para or mahalla want to play any game like cricket or badminton or table tennis. What can be done? The first job is to collect companions, selection of play ground and thereby selection of referee and taking permission from the seniors. Then buying playing instruments; if cricket bat, ball, stamp; if badminton net, pillars of net, cork, bat; if table tennis table, bat, ball. All companions collecting money to buy these instruments. Again, to keep some extra money to buy instruments whenever they are destroyed finished for playing. Another essential job is to maintain account of fund for income and expenditure regularly. This is almost called the playing in co-operative system.

To perform agricultural operations and in view of achieving maximum profit from agriculture, co- operative system can also be used. We shall call it agricultural co- operative. The agricultural co- operatives are generally of area based or regional based. Due to addition of science and technology in modern agriculture, agriculture has become very expensive. Besides, the farmers cannot hold the crops they produced. The price of crops fall down if there is bumper production. Sometimes, the price falls so that the farmers cannot get their production cost. If they have their own crop processing center and large store house in their area, this economic loss can be avoided. Although for single farmer (if not very large and rich farmer) it is not possible to achieve these benefits, each co- operative farmer will get profit proportionately to their land and capital; generally it is the base of co- operatives.

There is a proverb in the villages of Bengal: 'United we stand divided we fall'. That means the work which is unbearable load for a single person, if ten persons are united this load will not only easily bearable but also useful like a stick, if ten persons are united.

Agricultural co- operatives can make the farmers able to collect and use all necessary inputs required for modern agricultural technologies. Agricultural co- operatives can bring high level of ability in eco- friendly agricultural technologies like adopting crop rotation, use of intensive and integrated cultivation methods, crop security assurance by using integrated pest management methods, crop harvesting and post- harvest operations by mechanical means, transportation, storing and marketing and thus they can ensure achieving higher profit. Besides, agricultural co- operatives also provide farmers tolerance to sudden havoc. Now we shall discuss some utilities of agricultural co- operatives elaborately.

Types of co- operatives

Farmers can form various types of co- operatives based on the objectives.

- 1. Co- operative for agricultural capital (co- operative for savings):** objective is to collect necessary capital for co- operative.
- 2. Co- operative for agricultural inputs:** objective is to collect and use seed, fertilizer, pesticides, implements, transport, store etc.

3. **Co- operative for agricultural production:** to direct activities involved in agricultural production.
4. **Co- operative for marketing of agricultural products:** to determine price of products, take subsidy, to sell agricultural products and keep respective accounts.

Task: The learners will write down a report on the importance of agricultural co-operatives and will present.

Section-2

Collection of Agricultural Inputs and their Uses through Agricultural Co-operatives

We can divide agricultural inputs into several groups in large scale. We shall see that through co- operative, it is possible to collect these inputs in proper amount as well as we can ensure maximum profitable use of these inputs.

Agricultural land: It has been observed from research of both Bangladesh Agricultural University and Bangladesh Agricultural Research Institute that it is not possible to run an agricultural farm profitably without having at least one hectare of land. But most of the farmers of our country are the owner of lesser amount of agricultural land compared to this amount. Even those who have two and half acres of land or more, they also are not able to buy necessary instruments specially costly machineries to modernize the agricultural activities. If somehow they buy, they cannot get maximum use of these machineries. After completing own works, they have to keep the machine idle or to lease it. A large number of lands can be brought under same management practices through co- operatives. In that case, the maximum profitable uses of all other agricultural input can be ensured. If the co- operators (members of co- operative) become agreeable, rain water can be hold by converting some lands to water body from which irrigation water supply can be ensured whenever necessary. That means comparatively lower lands can also be brought under co- operatives. In presence of efficient and transparent management systems, the lands under co- operative can be increased up to four hundred hectare. But the land plan of land use can be arranged newly simultaneous with the increase in land area.

Water: Water is very important for agricultural activities. It is not possible to carry out any agricultural operation without water. In few decades ago, deep tube wells were recommended for agricultural operations in our country. Through gathering experiences, we have learnt that intensive use of deep tube well is not eco- friendly. The most secured water is the water of water body. It is best to use water from water body throughout the year by collecting rain water from water body in the rainy season. Irrigation water can be used in the lands under co- operative by constructing water body and supplying water from there through irrigation channels or pipes with the help of pump in lower cost. The cost of irrigation with surface water collected from the water body is comparatively very low. Besides irrigation, this water of water body can also be used in other works which profitable.

Agricultural machinery: Agricultural mechanization is necessary for the modernization of agriculture. Starting from power tiller and tractor, many types of machinery are used in all agricultural activities including crop production; rearing livestock, poultry and fishes. The buying, direction and maintenance of these instruments is not so easily possible under personal ownership unlike performing under co-operatives. Our agricultural production can go beyond the quality of other countries if used any agricultural equipment is used after collection by cooperative system.

Collection, production and uses of ingredients like fertilizer, medicine, seed, feed etc. for agriculture

Seeds, fertilizer, rearing cattle and poultry, fish feed and even major part of medicine for disease treatment can be produced by co-operative. Government agricultural service organizations provide seed, fertilizer, medicines. Co-operative can identify its yearly need previously and service organizations can provide that information earlier. Thus, national agricultural service organizations can take necessary steps in right time by knowing total demand of ingredients suitable for supply.

Agricultural loan: It is helpful for agriculture for getting required amount of agricultural loan safely and within the time. Loan providing organization will feel free to give loan if the agricultural co-operative is registered. Firstly: loan receiver has the registered identity, secondly: assurance for proper using of loan money, thirdly: and finally, assurance for capability of timely loan return to cooperative.

Task: Learners will make a list for agricultural ingredients that can be collected through cooperative.

Section-3

Preservation and Marketing of Agricultural Product on the Basis of Agricultural Co-operative

Production of agricultural product: Using of word "product" says that products are being produced on the basis of co-operative for their marketing and the producing products like crop, flour, fruits, fiber, seed, bamboo, wood, egg, milk, meat, hides & skin, fish or whatever it is. Main objective is to achieve profit. It is important to produce agricultural products so as to follow that it can not affect the health of producer and consumer of agricultural products and at the same time, it will be environment friendly.

According to the planning for production suitability of agricultural product and their production method, it is logical for production by considering the area of agricultural environment where co-operative is situated, types of land belonging to the agricultural co-operative, properties of soil, requirement of co-operative families and market and friendliness of environment. Preparation for proper management should be available so that no disease can break out in agriculture or in farm and farm can be kept safe

effectively even if disease breaks out. It is also important to collect produced product safely. After collection, some works for storage and transportation like sorting of classification, packaging or placing in proper container etc. are also helpful for product development and storage. It is required to storage for more or less time for marketing at suitable time. To store the agricultural product, it is required the suitable and effective container and also to create preservation environment. Rice, wheat, corn, various types of pulse etc. are to be required to dry at the specific level and kept in concrete store house with air tied container. These facilities cannot possible be created by one if he is not a rich farmer. Co-operative can easily make this arrangement. For marketing of agricultural product, another activity is safe transportation. Containers for transportation, age, packaging etc. are very important matter. Packing depends on product. Although gunny bag is suitable for transportation of crop, it is not suitable for transportation of vegetables, flower-fruits. To transport of these products, bamboo made basket or hardboard made paper box is required. Again, although bamboo basket is used for safe transportation of fish, big container filled with water is required for transportation of alive fish fries. Fish fries should be transported so as to way that they do not die due to lack of oxygen. Special tray is used for eggs transportation so that thousands of eggs can be transported together by folding. Again, special container is required for milk transportation. It would be best if the advance agreement is made between agricultural cooperative and related marketing organization for marketing facility. Co-operative can also make this arrangement.

Task: As individual work, learners will write down the marketing calculation in register note book and submit in the class.

Section-4

Importance of Co-operative Organization

If considering the above discussion on agricultural co-operative, we can understand easily that agricultural co-operative is an integrated activity. This noble activity is just started by the decision of being united of the persons who are interested about this matter before they are to be active in agricultural production by co-operative. Second, very important step is adding land and money to co-operative and before this, it is required for main condition of co-operative i.e. rules which are finalized after discussion. In this case, helps can be taken from the office nearer to national co-operative department. Suggestion can be taken from Upazilla Agricultural, Livestock and Fisheries Officer. Co-operative organization is to be established following the constitution of agricultural co-operative executed by department of co-operative. Such kind of co-operative can not be forwarded more by only making same opinion for doing agriculture altogether unless building up the co-operative organization. Rather than, it would be usual to cause premature death due to lack of transparency and submitting explanation. As a whole, a strong organization needs to be build up for all agricultural activities, production and marketing of agricultural products. Usually, it is called co-operative organization. This organization will strictly maintain the accountability of agricultural planning, implementation, production, preservation and

marketing. It also maintains the responsibility of profit distribution to each cooperative member according to their investment. The organization will receive service and keep accountability of donation, subsidy coming from service organizations of government and non-government level. It will make formal agreement with purchase organization of agricultural products, company or with individual and run business accordingly. Executive members of co-operative organization will be liable to general councilor and represent total explanation.

So, we can see that cooperative organization is the heart of agricultural co-operative. The cooperative members will get profit according to the skillness, honesty and strongness of the organization.

Task: Learners will make a report about the usefulness of agricultural co-operative and represent in the class.

Exercise

Short Answer Questions

1. What do you mean by agricultural co-operative?
2. How many types can be of co-operative?
3. Write down the necessity of agricultural co-operative organization?

Descriptive Questions

1. Describe how agricultural ingredients can be collected and used through agricultural cooperative.
2. Describe how agricultural products can be managed for production, preservation and marketing.

Multiple Choice Questions:

1. Which one is the environmental friendly agricultural technology?
 - a. Use of pesticide
 - b. Use of chemical fertilizer
 - c. Following crop rotation
 - d. Use of chemicals for preservation
2. To improve the quality of agricultural product-
 - i. Crop placement should be according to its quality.
 - ii. Produced crop should be preserved properly.
 - iii. Crop should be cared properly.

Which one is correct of the following?

- | | |
|---------------|-----------------|
| a. i and ii | b. i and iii |
| a. ii and iii | b. i,ii and iii |

Read the following paragraph and give the answer to the questions no. 3 and 4.

Farmers of Sidlai village could not produce expected crops due to lack of irrigation. To solve their problem, Nabo Jagoron Krishi Somobay Samitee has been built up with the help of Agricultural Officer Mr. Alam. By taking appropriate and environment friendly technology, farmers of Sidlai village are ideal of that locality today.

3. By this cooperative, the farmers of that area obtained-
 - i. benefits of using improved agricultural technology.
 - ii. assurance for achieving high profit.
 - ii. benefits of using chemical fertilizer.
4. Which environment friendly method has been taken by the farmers of that village for solving the problems?
 - a. To dig shallow tube well
 - b. To dig deep tube well
 - c. To build up water body on land surface
 - d. To manage irrigation by pump.

Creative Question

Parimal babu and Gomez babu live in Manipur village of Jessore district. Except homestead area, they have some cultivable land. Same phenomenon is also for their neighbour farmers. So, all of them struggle to maintain their family expenses. By taking suggestion from youth development worker and by leading of Parimal Babu, farmers of the village have built up the co-operative society and taken necessary steps for getting agricultural loan. On the other hand, by the leading of Gomez babu, everybody were involved with various jobs by establishing "Fool Nursary" through co-operative. By this way, they were able to earn within a short time.

- a. What is called agricultural co-operative?
- b. Explain how co-operative system teaches others to be active?
- c. Explain the way of activities taken by Parimal Babu.
- d. Evaluate the leadership of Gomez Babu for increasing farmers' income in that area mentioned in paragraph.

Chapter-Seven

Family Farming

Bangladesh is an agriculture based country. Agriculture is the key factor to run its economy. Farmers of this country maintain agricultural farm since the ancient period. Farmers produce crop, livestock, poultry and fish in their farms. The concept and importance of household agricultural farming have been discussed in this part.

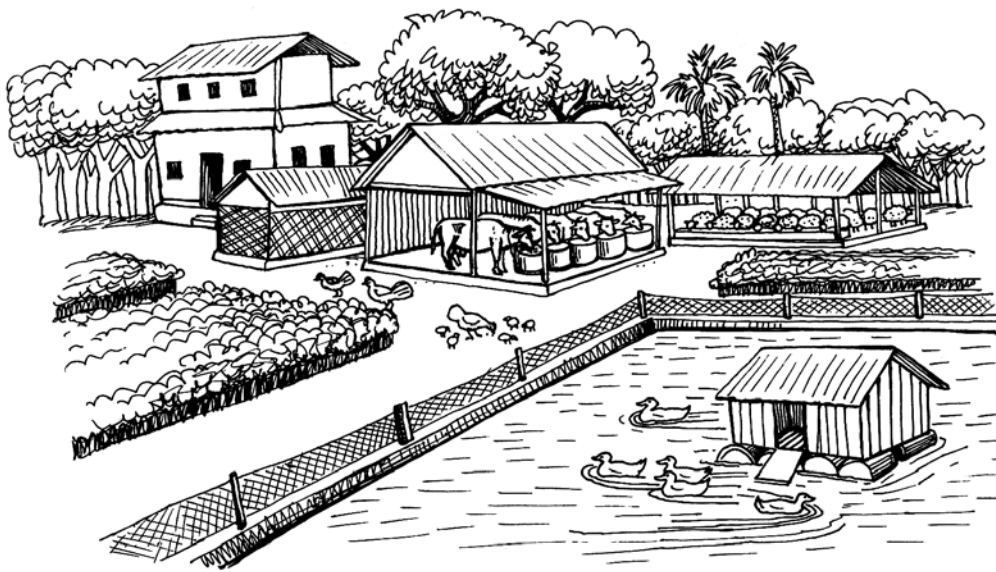


Fig: Family farming

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

- explain the concept of household agricultural farming.
- explain the techniques of making household agricultural farm and their health condition.
- explain the importance of household agricultural farming as a source of small income.
- describe the required tools for set up a household dairy farm.
- describe about milking cow and caring for calf.
- explain the old and modern method of milking and storage.
- describe the method of record keeping of household farming and their importance.
- describe the method of calculation of income-expenditure for farm production.

Section-1

Concept and Importance of Family Agricultural Farm

Family Farming

Farmers in Bangladesh produce crop, vegetables, livestock, poultry and fish by family agricultural farming. Farm may be commercial or household according to its size. Commercial agricultural farm is further categorized into large, medium and small. Big capital and manpower are required for commercial farm. But small capital is required for household farm. Household agricultural farm sometimes can earn some extra incomes after meet up the family needs. Now-a-days farmers are planning to set up farm by considering earning a decent income from family agricultural farm. Generally, family members maintain the family agricultural farm.

Importance of family agricultural farm

1. It meets up the demand of food and nutrition.
2. It plays role while guest received in a house.
3. It creates employment for unemployed family members.
4. It utilizes properly the leisure period of family members.
5. It creates opportunity for extra income for a family.
6. Fertility of agricultural land can be increased by livestock and poultry rearing.
7. Crop residues and by products can be utilized properly by livestock and poultry rearing.
8. Biogas can be produced by using livestock and poultry faeces and this can be used as fuel.
9. Household agricultural farm with proper planning helps to rise up the national economy.
10. It improves farmers' livelihood.

New words: Low income, Milking

Family Vegetables and Poultry Farm

Generally, the objective of family vegetables farming is to meet up the nutrition of household members. On the other hand, it plays an important role to improve household low income by producing agricultural products. This farm can be established around the homestead area, high and medium low land. If it is planned with the advice of the experienced farmers for cultivating seasonal crops, it can be possible to get crops round the year. It may also help to earn extra income after meet up the family needs. If it is cultivated advanced crops by household intensive care,

high market price may be achieved. Now-a-days, any of the vegetables can be produced year round which can meet up everybody's need. Vegetables can also be cultivated without applying chemical fertilizer and pesticides and in this way, safe and tasty vegetables can be grown.

Family Poultry Farm

Poultry means domestic birds such as chicken, duck, pigeon, guinea fowl, quail etc. Guinea fowl and quail are not so popular as they are not our native poultry. In this country, farmers have been rearing chicken, duck and pigeon in family poultry farm. Domestic poultry rearing is an integral part of farmer's culture in this country. From the past, farmers have been rearing native breed of chicken, duck & pigeon in the farm. Generally, farmers rear 5-15 chicken and duck in their farms. In this traditional farm, there is no improved housing and feed management. Chicken and duck live on grains and insects getting from around the homestead area. In this way, family demand for meat and milk are met up and sometimes, extra incomes are earned by selling eggs and chickens in the market. Here, commercial matter is not considered. But now, this concept has been changed. Farmers rear improved types of chicken and duck in order to get 250 eggs per year as because of low egg and meat production of native chicken and duck. Farmers have also been rearing high meat producing broiler in the household farms.

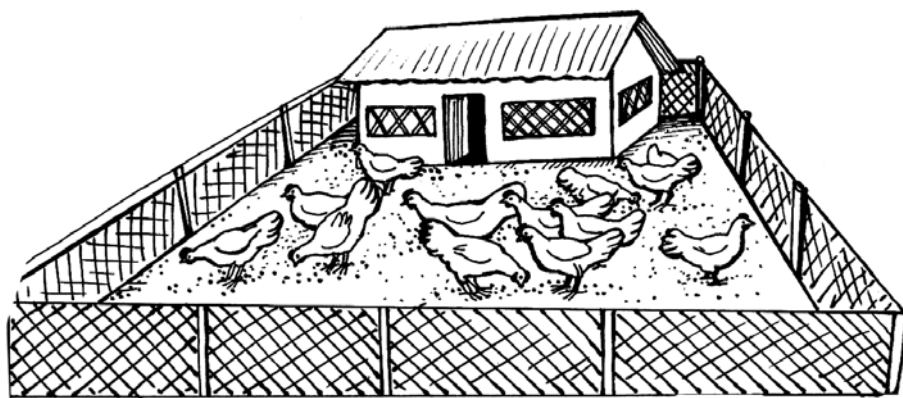


Fig: A household poultry farm

In this household farm, improved types of broiler or layer or duck have been reared up to the 50-300 numbers. Those farmers, who cannot cultivate crops, or rear cattle, goat and fish due to shortage of land, they can easily establish a chicken-duck farm.

There should be training for maintaining a family poultry farm successfully. Especially, knowledge on poultry breed, housing, feeding, disease prevention and vaccination program is required.

Poultry Health Management

Health management means keeping healthy the poultry by disease prevention and treatment of sick birds. "Prevention is better than cure"- this is more applicable in case of poultry. Because, if disease arises in poultry farm, no profit will be achieved

without treatment. So, following health management practices should be followed to maintain a household poultry farm.

1. To start the farm with healthy birds.
2. To set up the farm in flood free high land and to keep clean around the farmstead area.
3. To spray disinfectant sometimes around the farmstead area.
4. To make drain for proper drainage.
5. To make fence around the farm if possible.
6. To keep dry litter and floor of chicken house.
7. To make house with east-west long.
8. To facilitate proper ventilation.
9. To keep feeder and drinker clean.
10. To provide balanced ration and pure water.
11. To follow separate vaccination program for broiler, layer and chicken.
12. To keep worker's body and dress clean.

All birds should be destroyed and buried if disease outbreaks in epidemic form. Advice should be taken from a Veterinarian for curing of disease.

Family livestock farm

Like poultry, livestock rearing is also the feature of family agricultural farming of this country. In case of domestic livestock in our country, cattle, goat, buffalo and sheep are among them. Family farms with cattle and goat are found everywhere in Bangladesh. But buffalo and sheep are not available everywhere. It is possible for rich farmers to rear cattle and buffalo. On the other hand, goat rearing is easy for poor and landless farmers. Family goat farming is profitable in Bangladesh. Because, market price of goat is very high due to its higher meat demand. Black Bengal goat reaches to puberty early. They give birth to 2-3 kids at a time. Male goat (buck) can be marketed at 8 months of age.

Our native cow gives 1.0-1.5 liter milk daily. So, from such a family dairy farm, our nutritional requirement can only be met up but no extra income can be earned. There is no chance for loss in family dairy farming due to lower milk supply than our requirement. Holstein Friesian and Jersey crossbred cow can give up to 15-20 liter of milk. That's why; in Bangladesh, this type of improved crossbred cow should be reared in household farms. Many qualified young persons got success through making household farms with improved dairy breeds. In family farm, the number of cows may be of 2 to 5. If increase the cows' number, the farm is turned to a commercial farm and manpower should need to be recruited for proper management.

To maintain a family dairy farm successfully, training should be required. Especially knowledge on cattle breeds, production efficiency, housing, feeding, disease prevention and vaccination program is necessary.

Livestock health management

Health management means disease prevention and treatment of sick animals of a livestock farm. Disease prevention of animal should be emphasized rather than treatment. Because, if disease breaks out in farm, it will take more time to make animal productive after treatment. So, following health management practices should be followed to prevent disease during maintaining a livestock farm.

1. To set up the farm in high land and to keep clean around the farmstead area.
2. To control the entry of people.
3. To spray disinfectant regularly in farmyard.
4. To make drain for proper drainage.
5. To make cattle house with east-west long.
6. To facilitate proper ventilation.
7. To protect predators.
8. To keep feeder and drinker clean.
9. To provide balanced diet and pure water.
10. To wash animal.
11. To follow separate vaccination program for cattle, buffalo, goat and sheep.
12. To bury the dead animal.
13. To take advice from Veterinarian for curing of disease.



Fig: Washing of cattle

Task: Learners will visit a farm and write a report about farm health management

Family fish farm

Concept and importance of household fish farm

Ponds are available in many households of rural areas in our country. The ponds are used as a source of water for household activities. Generally in these ponds, some fishes are also cultivated by the old method. For example, fries are released in the pond and household left over rice and other food products are given to them. That's why; production of this pond is very less. But it is possible to increase enough fish production if the ponds are brought for fish rearing using high technology with proper planning. The fishes can also be sold in the market after meet up the household requirement. Besides, a mini pond can easily be made in the front and back side of the homestead area and the fish can be cultivated in this pond by considering it as family fish farm. This family fish farm can easily be maintained by household women. If women spend some times out of their regular job for fish farming, household protein

requirement may be met up and at the same time, they can also earn some extra income. Moreover, employment opportunity may be created for unemployed household members by establishing fish farm in family level.

Cultivable fish in household farm

Some of fishes which can be cultured in household farm and have an economic importance are described below:

A. Local fish:

Among the local species of fish, Rui, Katla, Mrigel, Kali baush are suitable for cultivation. These fishes are available everywhere in south Asia. During the rainy season (May-July), this type of fish release eggs in the shallow area of tidal river. Fry can be produced in the hatchery by natural or artificial breeding. During fish cultivation, fish meal, oil cake, rice polish, wheat bran etc. are provided as supplementary feed. If provided feed is sufficient, katla becomes 2-3 kg within a year. Rui and mrigel may become 1 kg weight within a year. Fishes of becomes two years old are able to release eggs.

B. Exotic fish

Some exotic fishes have been brought to our country for culture so that they can easily be adapted in our country and fries can also be easily produced in the hatchery. Some remarkable fishes of this type are Silver carp, Grass carp, Carpio, Thai shwarpunti, Tilapia, Nilotica and Thai pungush. This type of fish can be cultivated as mixed culture with native carp.

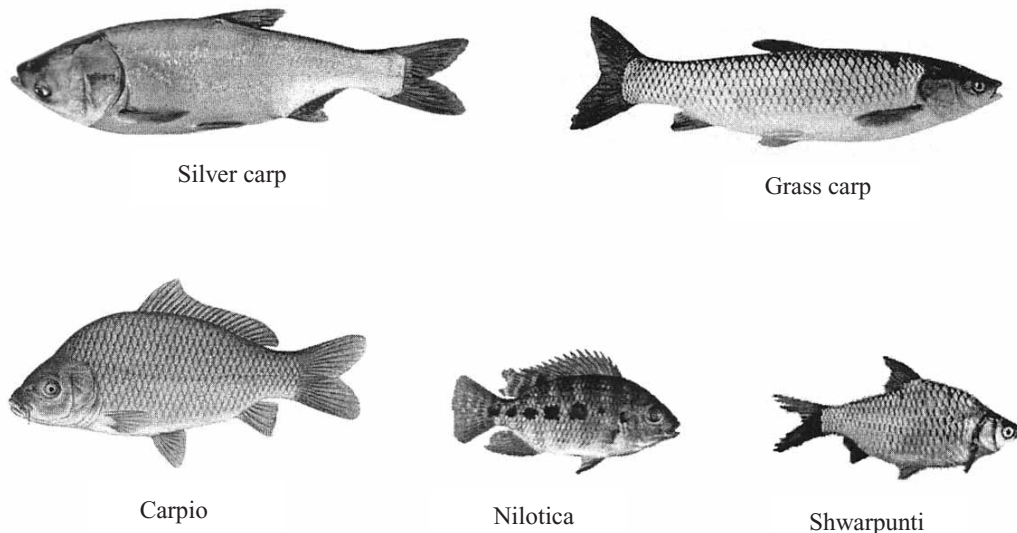


Fig: Cultivable some exotic fishes

Different steps for farm management:

Farm should be managed by different sequential activities. Different activities of farm management are-

A. Management practices before fry stocking in the farm (Pond preparation):

1. Cleaning weed from pond. 2. Removing predator & unnecessary fish 3. Repairing bank of pond 4. Application of lime 5. Application of fertilization 6. Examining the natural feed of pond 7. Toxicity test for water

B. Management practices during fry stocking: 1. Selection of fry species 2. Isolation of superior fry 3. Fry Purifying 4. Fixing the quantity of fry 5. Fry Transportation 6. Fry stocking and releasing

C. Management practices after fry stocking 1. Regular manure application. 2. Application of supplementary feed. 3. Evaluation of fish growth and health management. 4. Fishing and selling.

Various equipments for farm management:

Various equipments are required at different stages of farm management. The requirement of equipment for farm management at different stages is given below:

Stage of management	Requirement for equipment
Before stocking or pond preparation	Chopper, spade, fish killing poison (for example- rotenon), lime, Manure (Organic & inorganic), bucket, drum, manger, mug, secchi disk
During stocking	Fish larvae, polythene bag, common salt, potassium permanganate, P ^H paper, thermometer.
After stocking	Organic or inorganic fertilizer, manger, piece of bamboo, secchi disk, supplement feed, bucket, mug/pot, feeder, lime/gypsum, chopper/sickle, balance, torch for watching, net (lift net, cast net, seine net)

Health management for fish:

Fish may be affected by disease during cultivation. Measures should be taken instantly by observing the health condition of fish pulling them through netting in the pond once at every month. The general symptoms of fish disease include the inhibition of their normal movement, destruction of natural colour of gill, red/ black/ white spotted on their body, fishes are in off feed or intake less, feeling their body excessively coarse. During culturing, fish can be affected by some common diseases like ulcer, tail and fin rot, red futki, gill rot and argulus. If disease breaks out in the fish pond, advice should be taken from Fisheries Officer and management should be taken accordingly.

1. Fish Ulcer: Initially, punti, shol, taki, and subsequently carp fish are affected by this disease. Generally, the disease is observed in winter and summer. Disease prevention is easier than cure. Easy way of disease prevention is to apply lime in the pond regularly and to keep natural feed stable by applying fertilizer regularly in the pond. Some supplementary feeds are to be applied along with fish, extra fries are not to be stocked, no harmful products are thrown into the pond, no extra mud is allowed at the pond ground and no cast netting is to be applied in the pond frequently.

Some general problems and remedies of pond

1. Floating and suffocating of fish (lack of oxygen in the pond)

The problem of lack of oxygen in the pond water is caused due to the presence of excess mud at the pond ground, fermentation of organic matter, application of more fertilizer, turbidity, cloudy environment and increasing temperature. It causes the death of fish and shrimp. The mouth of dead fish remains opened condition due to lack of oxygen.

Remedies: Supply of oxygen in the pond can be increased by swimming in the pond, stirring pond water by hitting bamboo or by pulling "horra". In crisis moment, clean fresh water should be supplied or scattered by pump in the pond.

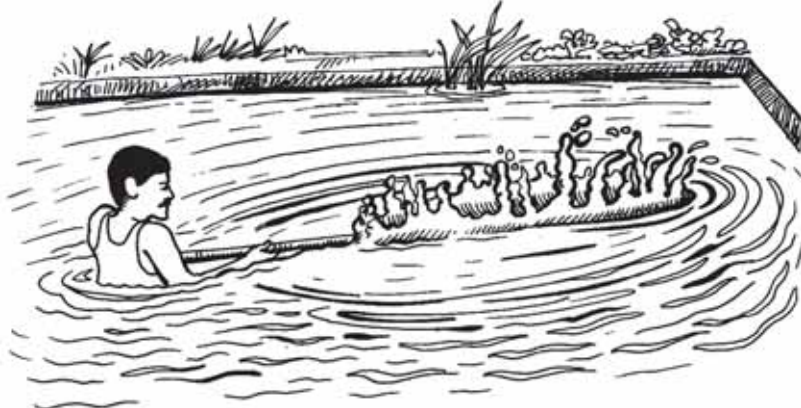


Fig: Stirring pond water by hitting bamboo

2. Green layer on water

This problem is caused by producing of extra green algae. It causes the inhibition of normal breathing of fish and suffocating fish on water. Environment is deteriorated by spoilage of algae. It causes the death of fish and shrimp.

Remedies: Algae layer can be removed out by thin cotton cloth. Temporarily supply of fertilizer and feed should be off. Water may be changed if required. It can be controlled biologically by releasing few big sized silver carp.

3. Red layer on water

This problem is caused for red algae or excess iron. It causes the inhibition of sunlight entering into the pond water. Production of natural feed for fish and shrimp is reduced. Moreover, it causes the lack of oxygen in water. Small packets with copper sulphate making at 12-15g per decimal are tied with bamboo and placed 10-15 cm deep in the pond water. Wave which can be created by air help to mix copper sulphate with pond water and algae can be removed out.

Remedies: Algae can be removed out by pulling straw or coiled banana leaves on water or using cotton cloth.

4. Turbid water

Water can be turbid by entering rain fall water into the pond. This may also happen due to the absence of grass on the bank of pond. That's why sunlight can not be entered into the pond water, fish gill is damaged and availability of natural feed in pond is decreased.

Remedies: Lime (1-2 kg/decimal), Gypsum (1-2 kg/decimal), or copper sulphate (240-245 g/decimal) can be applied in the pond.

5. Gas storing in the mud of the bottom of the pond:

Cause: This problem is arised due to the presence of excess mud in the bottom of the pond and decomposition of huge quantity of creepers and wastes. As a result, fishes die due to the toxicity of water.

Remedies: Excess mud has to be removed out from the pond when it is dried. Gas in bottom layer will be removed out by pulling horra.



Fig: Horra

The main objective of establishing household fish farm is to meet up household fish requirement and at the same time if possible develop the household financial status by selling some extra fishes in the market.

New word: Horra.

Section-2

Family Dairy Farm

Dairy cow farming is a profitable business. One should drink 90 litre of milk per year. But, people of this country can take in an average 10 liter of milk per year. So, there is a mark difference between milk production and requirement. The deficit can partially be met up by importing powder milk from abroad. Due to this deficit, people are being interested much to establish dairy farm from last two decades. Now, many people have been rearing cow as household farming in village, town and environs. More emphasis should be given on housing and feeding for rearing cow scientifically. Cow rearing increases employment opportunity, income of landless farmers in remote area, household nutrition and creates extra income. So, we can manage smooth earn

and meet up our milk requirement by establishing family farm with 2-5 cows in our homestead area.

Planning should be taken for establishing a cow farm with improved breeds. Small types of farm with 2-5 cows can be set up in household level. Generally commercial farms can be set up with 5 cows or more. If capital is taken from bank as loan, return status of bank loan should be considered during planning for a farm to be set up. Factors to be considered while selecting location of a farm are given below:

1. Comparatively high and dry land
2. Farm land development and build up.
3. Scope for farm extension
4. Far from homestead area.
5. Good communication system.
6. Availability of feed and water.
7. Considering product's demand and marketing system.

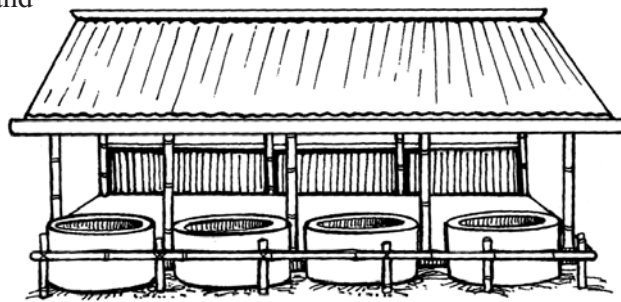


Fig : Family cattle house

Required materials for household dairy farm

Various materials are required for establishing a family dairy farm. Different materials including from capital to parturition of cow, are required for build up a farm. Quality should be considered during selecting and purchasing of materials. Introduction of materials is given below:

1. Capital
2. Farm land
3. Improved cow breeds
4. Standard farm house
5. Building materials for farm house
6. Improved feeder and drinker
7. Land for grass cultivation
8. Water line
9. Pick up/ motor van or rickshaw for transportation
10. Chopper for grass cutting
11. Feed trolley and different farm equipment
12. Utensils for milking and distribution.
13. First aid kit for animal.
14. Sufficient green grass and concentrate feed
15. Artificial insemination for animal.

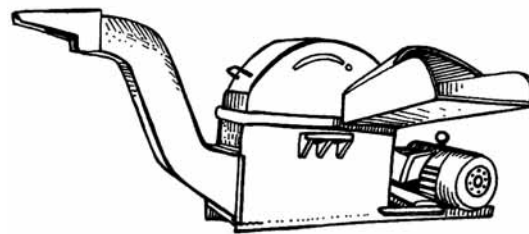


Fig: Chopper for grass cutting

Caring for cow

The objective of cow caring is to keep cow healthy and active. Care should take care of cow to get healthy calf during parturition. Following matters should be maintained properly for caring cow.

1. Cows should be walked around regularly.
2. Cow's hoof should be trimmed if necessary.
3. Cow's health should be checked regularly.
4. Never make the cow excited or disturbed during milking.
5. Routine deworming program of cow should be followed.
6. Cows should be vaccinated to prevent infectious disease.
7. Grooming (rubbing body using brush) of cow should be performed daily.
8. Sometimes, insecticides should be sprayed to protect insects and odd smell in house.
9. Cow shed should be kept neat & clean all times.
10. Washing of cow should be performed daily so that cows will not be affected by ticks, lice, flies, mites etc.
11. Milking of cow should be performed at the fixed time in every morning and afternoon.
12. Before milking, udder should be washed with clean water and at the same time, milker's hand should be washed with disinfectant solution.
13. If the cows do not come in heat after 90 days of parturition, cows should be checked up by a doctor to come into heat.
14. After parturition, placenta should be buried immediately after falling.
15. After birth, external part of urinary lining should be washed with disinfectant solution.

Task: Learners will make a list for materials of household dairy farm

Caring for calf

A healthy and strong calf can become a well productive bull or cow in future. Care should be taken for pregnant cow and calf for getting high productive cow. Traditional natural breeding with native bull has to be stopped and artificial breeding with modern technology should be practiced. In this way, we can get improved crossbred

calf for a dairy farm. Overall caring for calf is discussed below:

1. To get a healthy calf, balanced diet should be provided to pregnant cow.
2. Pregnant cow should be kept in neat & clean and dry place during parturition.
3. Birth place of calf has to be made soft by using dry straw and gunny bag.



Fig: Calf is the lay down on straw

4. Calf should be kept on gunny bag just after parturition and cleaned out mucus from the nose and mouth for easy breathing.
5. After cleaning, calf should be brought to near the cow so that it can clean the calf by licking mucus from nose, mouth, eye, and body.

If possible, calf coat should be dried thoroughly with dry cloth.

6. If the navel flap is not removed out, it should be cut by blade at 5 cm away from navel and used tincture iodine, benzene, dettol or savlon.
7. Colostrum should be provided to calf.
8. Calf and cow should be kept in separate room from other animal.
9. Care should be taken so that calf can take sufficient milk.
10. If required, Milk Replacer and Kid Starter can be provided.
11. Calf should be allowed for moving around so that it keep calf healthy and strong.
12. Male calf should be castrated timely.

Task: Learners individually will make a calf starter for calf and represent it in the class.

Milking

Milking may be defined as the process of collection of milk from the cow's udder. Milking should be performed at the fixed time and place by the same milking man so that cow become calm and maintain continuity of production.

Steps of Milking-

1. Milking time: Milking can be performed two or three times per day. If it is performed by maintaining specific time, milk production might be increased.
2. Preparation of cow: Never make exciting or disturbing before milking. Never beat the cows in any situation. Cows' udder and teat should be washed out with warm water before milking. After that, udder and teats are dried with clean cloth or towel.
3. Preparation of Milker: Milking man should wear a clean dress and covered his hair with towel or cloth. Milker's nail has to be kept clean by regular cutting.
4. Using clean equipment for milking: During milking from udder, milk with cover and handle should be used instead of simple bucket. After milking, milk can has to be washed with warm water initially and then with clean cool water by rubbing with brush. Milk can should be placed up side down until next milking.
5. Keeping cow free from fly: Care should be taken during milking so that fly can not disturb the cow.
6. Stimulation of cow for milking: Cow could be stimulated for milking by suckling teats by calf or massaging teats by milk man.
7. Feeding cow during milking: During milking, small amount concentrate feed or green grass should be placed in front of cow for keeping it busy.

Method of Milking: Method of milking is two types-

1. Old method: Milking by hand

2. Modern method: Milking by machine.

Any of the method should be followed during milking.

Milking by hand: During milking, teat is pressed after closing to its base. So,

accumulated milk in teat come out. After removing pressure, milk is accumulated again in teat from udder and the procedure is being conducted repeatedly. Milking is performed at the left side of the cow during hand milking. Milking is being performed using two teats together of the front side first and then using other twos of the rear side. Moreover, milking could be performed as cross (×) sign way –means, collecting milk first from front side one and rear side one teat together or from teats seemed to be more milk.

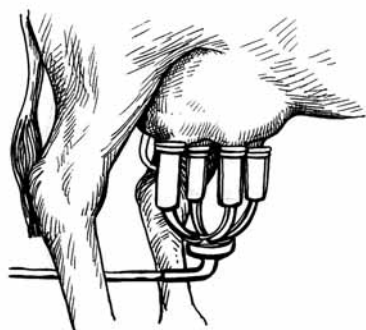


Fig: Milking by machine



Fig: Milking by hand

In large commercial farm where cow's number is more, milking machine is used for milking for many cows together. At the time of milking, machine is started by setting up teat cups with the teats. In this way, it is possible to collect milk easily and safely.

Task: Learners will discuss the comparative study of old and modern milking method.

Preservation of Milk:

Milk preservation may be defined as the process of keeping milk safe as drinking food for a definite period of time free from spoilage. Milk has to be screened and chilled immediately after milking. Milk preservation system is not so easy. Because, the chemical structure of milk is easily changed. Generally, raw milk is sold everywhere in Bangladesh. If milk is kept for long time in raw condition, milk quality is deteriorated. In normal temperature (room temperature), various microorganisms in milk cause sour taste by producing lactic acid. *Streptococci*, a microorganism, mainly produce acid in milk. In normal temperature, microorganisms cause deterioration of milk by their multiplication. Method of milk preservation is discussed below:

A) Old method for milk preservation:

Milk preservation by boiling: This method is most easy in household level. If boiling once, it will keep milk fresh up to 4 hours. So, if boiling milk for 20 minutes in every 4 hours, all kinds of disease causing organisms are destroyed, although their nutritional value may be decreased. Because, some vitamins and amino acids are destroyed by high temperature.

B) Modern method of milk preservation:

1. Milk can be preserved by keeping milk in refrigerator for only 40 seconds.
2. Milk can be preserved in deep freezer. Although micro-organisms are not multiplied here, but they break the chemical bond of milk. So, quality of milk is slightly decreased.

Milk preservation by boiling

Milk is one of the standard foods in the world. It is a standard food for calf as well as human being and at the same time it is similar standard for micro-organisms. After milking, milk quality is starting to be deteriorated by time and it is fully deteriorated if it is kept for long time in normal temperature. The deterioration may be caused mainly for microorganisms. The microorganisms can not grow and multiply in high and low temperature. Using this temperature, disease causing microorganisms could be controlled and the process is called pasteurization. The aim of milk pasteurization is to destroy disease causing microorganisms. To preserve milk long time, undesirable organisms should be destroyed and enzyme presented in milk should be neutralized.

Louis Pasteur (1860-1865), a French Chemist first realized that deterioration process had been caused by one kind of microorganism. Although pasteurization process had been invented by Louis Pasteur, but it was first applied by a German scientist, Dr. Soxhlet. Pasteurization is the process of heating the every particle of milk at 145°F (62.8°C) for 30 minutes or 162°F (72.2°C) for 15 seconds to destroy disease causing microorganisms and enzymes presented in milk. Milk has to be cooled down at 4°C immediately after pasteurization.

Advantages of pasteurization

1. Pasteurized milk is safe, because all disease causing microorganisms are destroyed.
2. Pasteurization increases the storage life of milk because it decreases lactic acid producing micro-organisms.

3. Enzymes in milk are destroyed by pasteurization and that's why milk can be safely stored long time.
4. Most of the pathogenic (harmful) bacteria are destroyed by pasteurization.
5. Pasteurization does not alter nutritional value and taste of milk.

Disadvantages of pasteurization:

1. Fat globules in milk may be emulsified by heavy stirring if pasteurization is not performed properly.
2. Heat sensitive vitamins may be deteriorated.
3. The taste of milk may be decreased by high temperature.

Types of Pasteurization:

1. Pasteurization with low temperature and long holding time: 62.80°C temperature for 30 minutes.
2. Pasteurization with high temperature and short holding time: 72.20°C temperature for 15 seconds.
3. Pasteurization with high pressure: 137.80°C temperature for 2 seconds.



Fig: Modern machine for milk pasteurization

Section-3

Record Keeping for Household Farm

Household farm is an economic institute. So, like other institutes, it is necessary to keep records for the statement of all kinds of land ownership of farm, detail information of expenditure or investment and all information of income and profit. A sample is presented below:

Name of Owner: Alif Miah

Address: Village: Boyra

Mouza: Boyra-Valuka

Upazilla/Thana- Mymensingh Sadar

Post Office- Mymensingh 2202.

Total land in household farm: Total 2 bigha (67 decimal)

High land	: 30 decimal
Medium low land	: 10 decimal
Homestead area	: 7 decimal
Pond	: 20 decimal
Farm	: 3

1. Fish farm	: 20 decimal
2. Vegetable farm	: 10 decimal
3. Broiler farm	: 3 decimal

Calculation of income and expenditure of broiler farm is described below.

Income and expenditure of the production of farm

Requirement of meat and milk can be met up by rearing of broiler and layer in household level. Moreover, extra income can be earned by selling broiler and table egg. A sample calculation for income and expenditure of broiler rearing with 100 birds is given below:

There are two types of expenditure for broiler rearing-

A. Capital or fixed expenditure

B. Recurring expenditure

Capital expenditure: It includes the total cost of land, housing, furniture, brooder, feeder, drinker, drum and bucket etc. before receiving chicks in farm. A table for calculation of expenditure of broiler rearing with 100 birds is given below.

Land	Making house for chicken	Brooder machine (Hover, chick guard, bulb)	Feeder & Drinker	Bucket & Drum	Total fixed cost
Own	Tk.8000.00	Tk. 2000.00	Tk. 1000.00	Tk. 1000.00	Tk. 12000.00

Recurring Expenditure: It is the total cost starting from purchasing chicks to daily needs in farm. Out of 100 birds, 2-5 broiler die up to complete rearing of broiler. Recurring expenditure includes the cost for chicks, purchasing feed, running electricity, vaccines and medicines, litter (bedding materials for chicken), labour and transportation etc. Broiler is reared up to 1 month.

A table for calculation of recurring expenditure of broiler rearing with 100 birds is given below as an example.

Chick price (Tk. 50.00/chick)	Feed purchasing (300 Kg, Tk. 33.00/Kg)	Electricity cost (monthly Tk. 300.00)	Vaccines & Medicines	Litter	Labour	Transportation cost	Total recurring expenditure
Tk.5000.00	Tk.9900.00	Tk. 300.00	Tk.1500.00	Tk. 200.00	Self	Tk. 500	Tk.17,400.00

Task: Students individually will calculate the income-expenditure of broiler rearing with 160 birds and submit it in the class

To calculate actual expenditure, depreciation cost has to be calculated based on the cost of chicken house, equipment, capital & recurring expenditure.

Total depreciation cost:

1. On chicken house (5% on Tk. 8000.00) = Tk. 400.00
2. On equipment or utensils (10 % on Tk. 4000.00) = Tk. 400.00
3. 15% on total fixed & recurring expenditure (Tk. 12000.00+Tk. 17400.00) = Tk. 4410.00

Total depreciation cost = Tk. 5210.00

If rearing 10 batch of broiler in a year, total depreciation cost for one batch will be = Tk. 521.00

Therefore, total expenditure = Total recurring expenditure + total depreciation cost for one batch = Tk. 17400.00 + Tk.521.00 = Tk. 17921.00

Income: Income can be obtained by selling of broiler, litter and gunny bags. Moreover, Litter can be used in land as bio-fertilizer and in pond as fish feed. A table for calculation of total income obtained from broiler rearing with 100 birds in household level is given below as an example.

Selling broiler- 95 numbers (5% mortality) Tk. 150.00 per Kg (Average body weight 1.4 kg)	Selling littre	Selling feed bags (6 pieces, Tk. 10.00 per piece)	Total Income
Tk. 19950.00	Tk. 100.00	Tk. 60.00	Tk. 20110.00

Net Profit = (Total income- total expenditure) = Tk. 20110.00 – Tk. 17921.00 = Tk. 2189.00

Task: Learners will write about the calculation method of income-expenditure and profit-loss of a farm.

New words: Fixed expenditure, recurring expenditure, littre.

Exercise

Short Answer Questions

1. What kind of fishes can be cultivated in the seasonal pond?
2. What are the materials required for establishing a household dairy farm?
3. What is pasteurization?
4. What do you mean by fish suffocating?

Descriptive Questions

1. Describe the importance of family agricultural farming.
2. Write down the name of 5 general diseases of fish and write down the causes, symptoms and remedies of any three diseases.
3. Describe the caring method for a cow in a family dairy farm.
4. Estimate the income-expenditure of a family poultry farm containing 200 broiler chickens.

Multiple Choice Questions

1. Which fish can be cultivated in family mini pond?

A. Mrigel	B. Grass carp
C. Shwarpunti	D. Pungush
2. Objective of pasteurization-
 - i. Destruction of microorganisms.
 - ii. Keeping the quality.
 - iii. Controlling the chemical properties.

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 answer the questions of 3 and 4.

Mr. Nihon cultured fish in a pond of his home yard containing 60 decimal area and 1.5 meter deep. After rainy season, he observed fishes rubbing their body with bamboo placing near the bank of the pond. He discussed with Fisheries Officer about this matter and Fisheries Officer gave him some suggestions.

3. By which disease fishes of Mr. Nihon's pond were affected?

- A. Ulcer
- B. Tail rot disease
- C. Argulus disease
- D. Red futki disease.

4. How many kg dipterex required for Mr. Nihon's pond?

- A. 1.5 kg
- B. 1.8 kg
- C. 2.5kg
- D. 2.8kg

Creative Question

1. Arif-Hasif have been rearing the chickens of native breed in their home yard for a long time. Due to not getting of much profit, they established a family poultry farm after taking training on poultry farming. They got success after a short period. But they observed that waste materials of their farm had been deteriorated household environment. In this situation, they took step for using farm wastes in the crop land by decomposition.

- A. What is family farming?
- B. Explain the importance of commercial farming.
- C. Explain the reasons for the success of Arif-Hasif.
- D. Explain with evidence for the entrepreneurship of Arif-Hasif.

THE END

2013

Academic Year

9-10 Agriculture

বঙ্গবন্ধুর স্বপ্ন- দারিদ্র্য ও নিরক্ষরতামুক্ত সোনার বাংলাদেশ গড়তে
নিজেদের যোগ্য নাগরিক হিসেবে গড়ে তোল
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পরিশ্রম কখনও নিষ্ফল হয় না



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