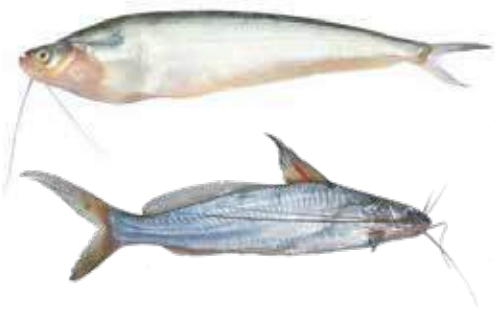
Agriculture Studies

Classes Nine and Ten









National Curriculum and Textbook Board, Bangladesh

Prescribed by the National Curriculum and Textbook Board
as a textbook for classes nine and ten from the academic year 2013

Agriculture Studies

Classes Nine and Ten

Revised for the year 2026

NATIONAL CURRICULUM AND TEXTBOOK BOARD, BANGLADESH

Published by

National Curriculum and Textbook Board

69-70, Motijheel Commercial Area, Dhaka

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First Edition : September, 2012
Revised Edition : September, 2014
Revised Edition : October, 2024
Revised Edition : October, 2025

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

Printed by :

Preface

The importance of formal education is diversified. The prime goal of modern education is not to impart knowledge only but to build a prosperous nation by developing skilled human resources. At the same time, education is the best means of developing a society free from superstitions and adheres to science and facts. To stand as a developed nation in the science and technology-driven world of the 21st century, we need to ensure quality education. A well-planned education is essential for enabling our new generation to face the challenges of the age and to motivate them with the strength of patriotism, values, and ethics. In this context, the government is determined to ensure education as per the demand of the age.

Education is the backbone of a nation and a curriculum provides the essence of formal education. Again, the most important tool for implementing a curriculum is the textbook. The National Curriculum 2012 has been adopted to achieve the goals of the National Education Policy 2010. In light of this, the National Curriculum and Textbook Board (NCTB) has been persistently working on developing, printing, and distributing quality textbooks. This organization also reviews and revises the curriculum, textbook, and assessment methods according to needs and realities.

Secondary education is a vital stage in our education system. This textbook is catered to the age, aptitude, and endless inquisitiveness of the students at this level, as well as to achieve the aims and objectives of the curriculum. It is believed that the book written and meticulously edited by experienced and skilled teachers and experts will be conducive to a joyful experience for the students. It is hoped that the book will play a significant role in promoting creative and aesthetic spirits among students along with subject knowledge and skills.

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

It may be mentioned here that due to the changing situation in 2024 and as per the needs the textbook has been reviewed and revised for the academic year 2026. It is mentionable here that the last version of the textbook developed according to the curriculum 2012 has been taken as the basis. Meticulous attention has been paid to the textbook to make it more learner-friendly and error-free. However, any suggestions for further improvement of this book will be appreciated.

Finally, I would like to thank all of those who have contributed to the book as writers, editors, reviewers, illustrators and graphic designers.

October, 2025

Professor Robiul Kabir Chowdhury
Chairman (Additional Charge)
National Curriculum & Textbook Board, Bangladesh

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Chapter One
Agricultural Technology

Agricultural activities and agricultural technology go hand in hand. Basically, agro-technology includes all the tools which are used in agriculture. Every agricultural work has relation with specific agro-technology. Presently, agriculture is not only a means of supplying food at family level; but it also becomes a professional business. In the past, agriculture meant tilling land and sowing seeds in the field to collect food and storing it in the house for a year. Now, agriculture is a business of profit or loss based on cost-benefit analysis. So, agricultural problems are now becoming more complex. Moreover, agricultural scientists are innovating high-quality agricultural technologies. In the previous classes, we have learnt about the different agricultural activities and technologies being used in agriculture. Now, we shall learn more about land preparation, features of soil for different crops, soil fertility, soil erosion, preventing soil erosion, seed preservation, pest control and the increasing mechanization of farm work.



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

- select crops basing on soil and environment;
- describe the methods of land preparation mentioning its steps;
- analyze the necessity of land preparation;
- explain soil erosion, causes and types of soil erosion;
- describe the harmful effects of erosion;

- analyze the ways of preventing soil erosion;
- describe the methods of seed preservation;
- explain the importance of seed preservation;
- preserve crops seeds;
- explain the necessity to preserve fishes, animals and poultry feed;
- describe the steps regarding preservation of the feed of fishes and animals;
- explain supplementary feed;
- prepare a list of supplementary feed for fishes, animals and poultry birds;
- describe the methods of applying supplementary feed for fishes, animals; and birds;
- analyze the necessity of supplementary feed for nutrition and rapid growth of fishes, animals and poulry birds.

Section-1

Crops selection

Selecting crops based on soil and environment

Soil is one of the main medium of growing crops. Soil is a natural source of water and nutrient. All sorts of crops do not grow well in all types of soil. For example, rice grows well in clay soil or clay loam-soil; whereas, groundnuts grow well in sandy or sandy-loam soil. However, since the soils of Bangladesh are formed by the siltation of the Ganges, the Brahmaputra and the Meghna; more or less all types of crops grow here. Most of the soils of Bangladesh are loose, light, dusty and cultivable. Soil means the substance where crops grow, forests develop, and livestock graze. To a farmer, soil is that part of the earth which can be ploughed or cultivated for crops. That is, in the light of the farmers' knowledge 15 to 18 cm deep layer of the surface of the earth is called soil. Therefore, soil properties suitable for crop production remain in this very layer.

Earlier it is said that more or less all types of crops grow in the soils of Bangladesh. But the soil properties of all the regions are not the same. So it is seen that rice grows well in some areas whereas wheat, potato and jute grow well in other areas.

Soil properties suitable for various crops production are given below :

Soil properties suitable for Rice	Soil properties suitable for Wheat
1. Except stones and sandy soils; all soils are suitable for rice cultivation. Clay and clay-loam soils are the most suitable for rice cultivation. Rice grows well in silty river basin and haor–baor areas	1.High and intermediate land are suitable for wheat cultivation. Wheat is also cultivated in the medium low land.
2. Based on the types, rice can be cultivated in high, medium, low and all types of lands. For example, boro and deep water rice can be grown in low land.	2. Loam or sandy-loam soils are suitable for wheat cultivation. wheat also grows well in clay loam-soil.
3. Soils having p^H range acidic to neutral are suitable for rice cultivation.	3. Wheat grows well in the northern districts of Bangladesh. Besides, it is also cultivated in Dhaka, Cumilla, Tangail and Faridpur
4. If organic matter is lower in soil, it can be increased by applying compost.	4. Wheat is not cultivated in all agricultural areas of Bangladesh. Specially wheat is not cultivated in haor-baor and marshy areas.
5. Determining the level of nitrogen, phosphorous, potash, zinc, sulphur etc, soil fertility can be increased by applying necessary amount of fertilizer.	5. Wheat grows well in soils having P^H 6.0-7.0

Soil properties suitable for Jute	Soil properties suitable for Pulses
1. Jute grows well in the silty fertile land of the river. The Brahmaputra, the Jamuna, the Meghna etc. 2. River estuary's deep silty soil is specially suitable for jute cultivation. 3. Jute also grows well in loam and sandy loam soil.	1. Pulses grow well in the loamy, sandy loam, clay loam and silty loam soils of high and medium land. Pulses cannot witstand excessive water. So, soil from where water can easily be drained out is suitable for pulses. 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 give good yield if these conditions prevail and if the soil is clay loam rather than sandy 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.

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

Soill properties for vegetable crops

All types of vegetables grow well in high, well- drained, loam, sandy loam and silty loam soil. The soil properties suitable for potato and tomato cultivation are descried below:

Soil properties suitable for Potato	Soil properties suitable for Tomato
1. Loam and sandy-loam soil is very suitable for potato production.	1. Tomato can be cultivated in any types of soil except sandy soil and soils having gravel.
2. Well-aerated soft and loose soil is suitable for potato. These conditions facilitate potato tuber to become larger in size.	2. Loam and sandy- loam soils are suitable for tomato cultivation.
3. Potato requires adequate amount of organic matter in soil.	3. Tomato can be grown in sandy soil if higher amount of organic matter is added to soil.
4. It is better to have P^H range 6.0-7.0 in the soil.	4. Soil having P^H 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.

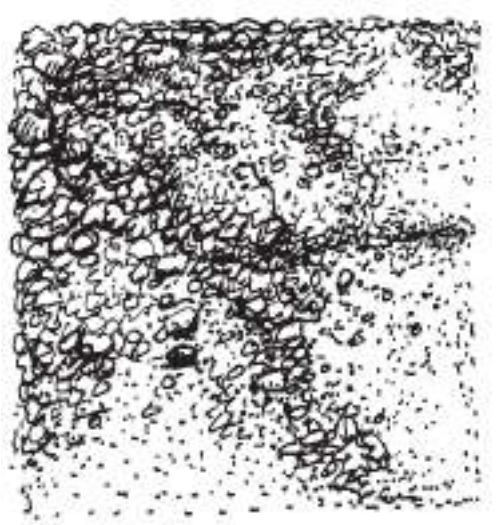
Crop selection acccording to the characteristics of soil-based Ecological Zones

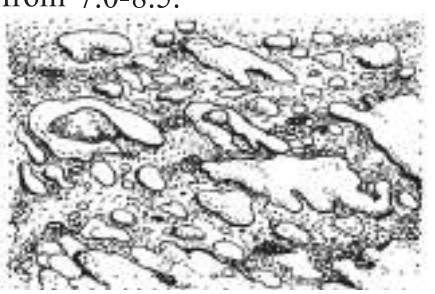
From the previous lessons, we have learnt to describe soil properties based on the classification of crops. We shall learn to select crops according to the soil properties in this lesson. Soil properties means soil classes, organic matter content, potash mineral content, soil p^H and soil topography. We have certainly learnt that Bangladesh is divided into 30 Agro-Ecological Zones based on the nature or properties of soil. Actually, a certain Agro-Ecological Zones 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 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 regional based on soil properties are shown below:

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

Soil - based regions	Crops suitable for cultivation
1. Loam and silt loam soil ragion In this region, the type of soil is loam to silt loam. From high land to medium low land are under this region. The organic matter content in loamy soil ranges between low to medium. The p^H of this region ranges between 5.2 and 6.2; organic matter content in loamy soil is very low.	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. Again, the farmers grow crops depending on irrigation facility also. The name of rainfed and irrigated crops are mentioned below: **a) Rainfed crop selection** **Rabi season:** Wheat, radish, tomato, cauliflower, cabbage, okra, chili, groundnut etc. **Kharif-I:** Transplanted aus, broadcast aman, jute (white), foxtail millet, brinjal, sesame, mungbean, broadcast aus, maize, dhaincha etc. **Kharif-II:** Transplanted aman (Local improved varieties and HYV). **b) Irrigated crop selection** **Rabi season:** Boro, sugarcane, sugarcane + potato; sugarcane + mung bean, onion, garlic, wheat, potato, mung, mustard etc. **Kharif-I:** Transplanted aus, jute (tosa), sesame, maize **Kharif-II:** Transplanted aman (Local improved varieties and HYV)

Soil - based regions	Crops suitable for cultivation
2. Clay soil region The medium-high land and medium low land of this region are clayey. But in some cases, silt-clay soil is also seen. Organic matter in this soil is moderate. In some cases organic matter is high. Potash containing minerals are moderate.	Clay soils predominant in medium low and low land in this region. Rice production is good in clay soil. The name of rainfed and irrigated crops are given below: 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 prevail.
3. Barind and Modhupur tract High and medium high lands are main feature of Barind and Madhupur tract region. The lands of Madhupur tract are plain and high. Soil is loamy with low organic matter and potash minerals. Soil P^H ranges from 5.5-6.5  Fig: Loamy soil	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: **a) Rainfed crop selection** **Rabi season:** Boro, mango, potato, mustard, lentil, chickpea, barley and winter vegetables. **Kharif-I:** Broadcast aus, jute, foxtail millet, summer vegetables **Kharif-II:** Transplanted aman (Local improved and HYV). **b) Irrigated crops selection** **Rabi season:** sugarcane, sugarcane + potato, wheat, mustard, groundnut, lentil, tomato, cabbage, chickpea, winter vegetables. **Kharif-I:** Transplanted aus, jute, mung, ladies finger. **Kharif-II:** Transplant aman (Local improved and HYV).

Soil - based regions	Crops suitable for cultivation
4. Hilly and Piedmont regions Above 90% of land of this region is high. Khagrachhari, Bandarban, Rangamati, Cox's Bazar and Akhaura belong to this region. The soil of this region is loamy. Organic matter and potash mineral content are low. The p^H of the soil of this region ranges from 5.0-5.7.	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: **a) Rainfed crops selection** Rabi season: Sugarcane, mustard, lentil, chickpea, wheat etc. Kharif-I: Broadcast aus, jute, broadcast aman. Kharif-II: Transplanted aman. **b) Irrigated crops selection** Rabi season: Sugarcane, sugarcane + potato; sugarcane + lentil; boro, wheat, mustard etc. Kharif-I: Dhaincha, broadcast aus, transplant aus. Kharif-II: Transplanted aman (Local improved varieties and HYV)
5. Coastal region Saint Martin's island, Chittagong, Feni, Noakhali, Barishal, Bhola and areas attached to Bay of Bengal of belong to coastal region. Most of the lands are medium high land. Its soils are loamy, sandy and silty-in nature. Here soils have low organic matter and potash mineral content. Soil p^H ranges from 7.0-8.5.  Fig: Silt- loam soil	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: **a) Rainfed crops selection** Rabi season: Wheat, mustard, mung bean, chili, onion, garlic, radish, brinjal, bean, tomato, groundnut, maize etc. Kharif-I: Brtoadcast aus, transplanted aus, jute, teasel gourd etc. Kharif-II: Transplanted aman (Local improved and HYV). **b) Irrigated crops selection** Rabi season: Boro, tomato, potato, mustard, water melon, mung bean, chili etc. Kharif-I: Transplanted aus Kharif-II: Transplanted aman (Local improved and HYV)

Task: Students will write a report on the nature of the soil and describle the characteristics of soil of his 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 broadcast in the main field without raising seedlings. Wheat seeds are also broadcast almost similarly in the field by cultivating land well. Various activities are involved in land preparation such as ploughing, harrowing, fertilizer application etc. Crop-wise tillege activity is described below:

Land preparation for rice cultivation

In Bangladesh, rice is cultivated all the year round. But in the most cases, seedlings are raised in seed bed. We will learn about seed bed preparation and land preparation in the first section of the Fourth Chapter.

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. If the favourable condition of soil ('Joe' condition) for ploughing exist, farmers will plough the land. For wheat cultivation, soil is made friable by 3-4 ploughing and cross- ploughing followed by harrowing. Care should be taken so that no larger clods remain in the land. Loam or sandy-loam soil is suitable for wheat cultivation as these soils are easily friable. Ploughing may also be done by rotavator connecting with a power tiller followed by harrowing. 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 cultivation is not done for pulse crops in Bangladesh. But one or two ploughing operations are done for lentil and gram cultivation. At the end of monsoon, when water is drained out from 'char'-the lowlying areas; the lentil seeds are sown in silty soil without any tillage. If possible, one or two ploughings are also done. After ploughing, pulse seeds are sown on fallow land and sometimes these are sown in the transplanted and broadcast amon land despite having crops.

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 a bit earlier in the high land. Generally, potato is cultivated in loam or sandy-loam soil. For potato, field is made friable by ploughing 5-6 times followed by several harrowing. Nowadays, land is prepared with the help of power tiller and soil gets friable by ploughing 3-5 times and thereafter land is made prepared.

Furrow making and fertilizer application

After ploughing and harrowing 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 involved in tillage. For example, seeds to be sown in the suitable place in proper depth for germination, to create easy air movement condition, to bring the soil of the upper area in the low and the soil of the low area in the upper area and also to increase water-holding capacity. For realizing this importance, tillage can be defined as 'The process through which the soil is cut, made weed free, softened loosed 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. For that reason, they used to make pointed wood or stone implements. They used to cut, harrow 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 ignored.

There is a proverb of Khana regarding land preparation–

"Sixteen ploughing for Mula
Half of it for Tula
And half of above for Dhan
And no ploughing for Paan."

It means, sixteen ploughings are for raddish cultivation. Eight ploughings are required 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. Now a days, farmers themselves cultivate maize, pulses etc. without any tillage.

Task: Sometimes learners will visit field. They will observe the preparation of land 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.

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. **Making soil suitable 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 and fine. Therefore, a physical soil condition is created which is favorable for seed germination and crop growth. In what manner and to what extent the land will be prepared depends on the soil types, soil organic matter and moisture, and types of crops. Tillage by 3/4 ploughings and harrowing in light soil like loamy, sandy or sandy-loam soil can make the soil suitable for crop cultivation; whereas, the heavy soil like clay soil requires 5/6 ploughings. Soil gets friable if there is moisture in soil during ploughing; otherwise ploughing creates larger clods. The soil particles remain granular and consolidated if there is high organic content in soil; and the soil preseves the seed well and helps to germinate easily.
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 mixed with 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 in organic matter and fertility.
3. **Controlling soil- borne insects:** There are many insects in soil which are very harmful to crops**.** During tillage, 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, soil absorbed fertilizer and irrigation

more. Thus, water-holding capacity of tilled soil is more. In that soil, when seeds are sown, they germinate and grow quickly.

5. **Increasing microbial activities in soil:** Various micro-organisms help soil keep health good. Among them, fungi and bacteria are the main. These organisms, remaining in soil, help to decompose soil organic matter. Proper tillage, helps activate these soil organisams. As a result, plants can uptake nutrient easily and yield good crops.
6. **Controlling soil erosion:** Another important objective of tillage is to level high-low soil and compact the land. Consequently, rain or irrigation water cannot flow outside the land. Thus, tillage prevents soil erosion and ensures proper utilisation of water.

Factors influencing land cultivation

The way of land cultivation depends on some factors. These are as follows:

1. Types of crops
2. Types of soil
3. Weather
4. Types of farm

1. **Types of crops:** Land cultivation depends on farmer's selection of crops to be cultivated. For example, to cultivate rice, the land are prepared by ploughings and cross-ploughings followed by harrowing. But radish, chili and other crops require much ploughing to make the soil friable. Cultivation of sugarcane and potato require deep ploughing.
2. **Types of soil:** Land cultivation depends on the types of soil. Clay soil, having high moisture or if they are wet, cannot be ploughed. It requires to wait until the favourable condition of soil for ploughing exists. Again, light soils such as, loam, silt-loam and sandy-loam, containing high moisture, can also be ploughed. These soils are very suitable for cultivation.
3. **Weather:** Soil moisture varies with the weather condition. Moisture deficit prevails in soil if there is scarcity of rainfall. In this condition, deep ploughing will cause serious moisture deficit in soil. Again, in monsoon, sufficient moisture exists in soil and the land preparation becomes easier for transplant aman seedlings.
4. **Types of farm:** In intensive crop cultivation, just after harvesting one crop; another crop is consecutively cultivated. At that time, ploughing is not necessary as the soil remains 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 and water becomes turbid. The mud-mix water flows downward. 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 swept away with wind from one location to other. These soil particles will hit your eyes and face if you are outside. Now, probably you can say that transportation of surface soil due to various reasons is called soil erosion.

By the processes of soil erosion, eroded soil is deposited on the lowest slope. The main causes of soil erosion are rainfall, cyclone, river flow, cultivation after deforestation, cultivation on hilly slopes etc. Due to continuous rainfall, soil lost its water-holding capacity and then the excess water carries away some surface soil particles towards the lower slope. By the current of water, surface soil becomes loose and tends to deposit on the lower slope. Similarly, wind brings away the soil from the cultivated land in the form of dust. River flow breaks the bank of river and brings away the soil and creates char land. When men clear the forest to cultivate crops, the land becomes open. Again, livestock also graze. Thus, soil erosion occurs. Similarly, by clearing hilly forest, crops are cultivated on hilly slopes. By the current of rain water, surface soil falls on the valley.

Types of soil erosion

There are two types of soil erosion: (1) Natural soil erosion (2) Man-made Soil erosion. These are discussed below:

A. Natural soil erosion: Nature exerts a strong influence on soil erosion. This type of erosion has started from the beginning of earth. Somtimes a strip of char rises out of a river bed due to natural soil erosion. Many areas of the world become fertile and many become unfertile in consequence of this type of erosion. Naturally, soil erosion occur 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. 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 continuous soil erosion.

Classification of natural 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 scale 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 erosion are discussed below

1. 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 such fertility is not but sheet erosion.

2. 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 loses its fertility and it becomes problematic for the farmers to use implements.

3. 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 duration. Therefore, the crop soils go under more erosion. After a certain period, these channels look like drains or small rivers. The more the rainfall is the more channel erosion occurs. This type of soil erosion is found in the hilly regions of Bangladesh.



Fig. : Rill erosion

4. 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 regions. At the beginning or in 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 water.



Fig. : River bank erosion

Wind erosion

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

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

B. Soil erosion man-made: Men need food to survive. From the beginning of agriculture, men are using soil injudiciously to produce



Fig. : Soil erosion man-made

food. Tillage, irrigation, drainage etc. are main components of agricultural activities. Soil is continuously disturbed by these activities. Thus, lands are exposed to the natural forces like rainfall, wind etc. and get eroded. The more the soil is used, the more soil erosion occurs.

Uncovered lands are being attacked by the rainfall, wind, 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, during grazing of livestock and movement on the field path, the particles of soil fly away 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. Thus soil fertility is lowered considerably.

(2) Soil erosion makes 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 flood inundates the country. Thus it damages crops, birds, households etc.

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

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

Causes of soil erosion

Soil erosion is caused by several reasons. From the above description of soil erosion, the causes of erosion can also be 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) Wind (8) Human activities

Rainfall: Though rainfall is good for cultivation, it causes soil erosion. The intensity, number and amount of rainfall affecte 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 lose 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: In the sloppier soil water moves with high speed towards the lower slope. For that reason, the soil erosion is higher in hilly area compared to plain land. Generally, zoom cultivation practiced in Bandarbans, 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 a little rainfall causes soil erosion moving soil surface 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 is eroded due to rainfall. The steps are created on the steep hills and crops are cultivated on that steps. But if it is not cultivated in normal way, landslide or soil erosion may be caused also. Frequent cultivation of land also may cause soil erosion.

The crops which cover the soil can save the soil from erosion such as groundnut, black gram, grass pea etc. But sugarcane, maize, rice, wheat etc. do not cover the soil in their initial 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: Human beings themselves are the actual cause of soil erosion. To manage food for hunger, men started clearing forests. Thus soil surface becomes open and causes soil erosion. Men also cause soil erosion by destroying agricultural lands for the construction of residence, roads etc.

Effective 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-

a. Lowering the speed water flow

1) It is important to decrease the speed of water flow for controlling soil erosion. Strong current of water flow can be decreased by several ways, such as, setting up ridge of earth around the cultivable field. Then soil of the field gets time to absorb water and thereby soil erosion can be prevented.
2) If the small canals created by rill erosion are filled up and leveled, water flow will be decreased and will 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.
4) Moreover, by dumping bits of dry grass, straw and leaves at the foot of the wire netting the current of water can be slowed down and thus erosion of soil can be prevented

b. 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.

c. 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 less, soil of this land can easily be eroded.

d. Crop cultivation on the slopes of hill

Because of zoom cultivation crops are cultivated on the lines created across the slope of a hill. Since the crops are cultivated across the slope, the speed of the rain water flow becomes slower. And this type of cultivation does not erode soil of the hill.

e. Cultivation in Contours

Cultivation of crops directly across the slopes of hills is known as contours method. This method slows down the seed of rain water and saves soil erosion.

Task: 1. The learners will write a report on the soil erosion of the agricultural land in their own area presenting preventing measures.

2. The learners in groups will write poster to raise public awareness on soil erosion control and will present in the class.

Section-4
Seed Preservation

Process of seed preservation

Seed preservation starts from seed production. Seed preservation process comes to an end with sowing transplanting in the field. So, it is seen that seed preservation includes 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 other varieties from crop lands;
   (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 .

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 assential 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 percentage of pure seed is known as purity test.

Seed germination test

How many seeds in a seed sample are germinated on percentage basis is determined by a test. This test is known as seed germination test. Germination starts when seed moisture content exists 35-60% or above. It is expressed in percentage terns. 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 is 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:

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

Seed vigor test

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

Seed marketing

Seed marketing is a remarkable part of seed technology. Seed collection, packaging, seed preservation before sale, notification, selling etc. are combinedly known as seed marketing.

The following information is to be given to the customers during seed marketing:

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

Importance of seed preservation

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

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

Methods of seed preservation

There are several methods of seed preservation in Bangladesh. Different seeds require different methods of preservation. Such as for cereal crops like rice, wheat, maize seeds are preserved in barns earthen pots, gunny bags, poly bags and beds. 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 are be tested by biting. If the bite creates the ‘crunch’ sound, it ensures the proper drying. Thereafter the seeds are kept in the gunny bags and closing the openings and these are kept in the store house. The neem leaves, neem roots, dust of apple seeds, bishkantali etc. are mixed with the seeds bags to save the seeds from insect attack.

Preserving rice in a barn

To preserve 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 preseving seeds. The seeds should be kept in the gola so that the gola becomes airtigh. 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 made of bambo slips)

Dol is smaller than rice granary in size. It is round in shape and 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 suitable for preserving seed after drying well.



Fig: Seed preservation in dol

Preservation in polythene bag

Nowadays, 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 very thick and very durable. 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 grannary. After that a lid is to be placed for covering motka and sealed with coating.

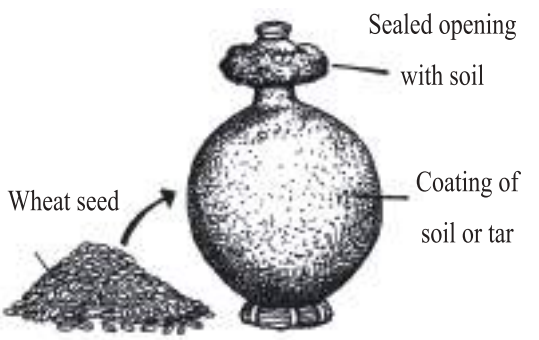


Fig: Seed preservation in motka

Task: Learners will make a report about a method– how to preserve seed in earthenware jar and submit and present it in the class.

Section-5
Feed Preservation

Importance of preservation 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 oilcake, 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 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 preserve 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:** High temperature deteriorated the quality of nutrients in feed. Insects grow fast at 26-30°C and they 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 preservation

a) Dry feed and feed ingredients

1) Feed should be preserved in airtight 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 that is clean, dry, safe and well ventilated.
3) In storage room, preserved 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 blackcoated or non transparent pot.
3) Vitamins and minerals should be kept in refrigerator with in a pot free from air and light.

Task: Learners will discuss feed preservation method and represent on a poster.

New word: Rancidity

Importance of preservation of livestock feed and preservation method

Feed preservation may be defined as a method of processing feed by maintaining its 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 preservation

In Bangladesh, most of the livestock feeds are crop by products. These by-products are available after harvesting of crop or grain processing. Green grass remains surplus even after feeding of livestock due to their huge production in rainy season. On the other hand, excess leguminous grass are also cultivated during winter. So, these surplus green grass needs to be preserved and can be supplied to livestock during scarcity. The main objective of feed preservation is to protect feed from micro-organisms 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, livestock die after sickness.

Steps for feed preservation

a) Green grass can be preserved by making hay. In part 2, hay making has been discussed. Furthermore, different steps for hay making are also given below-

   1) Leguminous grass 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) After drying grass , it should be kept on slat by piling or in tin shed.

b) Green grasses can be preserved 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 in fresh condition at flowering stage.
   3) After cutting, grass should be kept in airtight 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

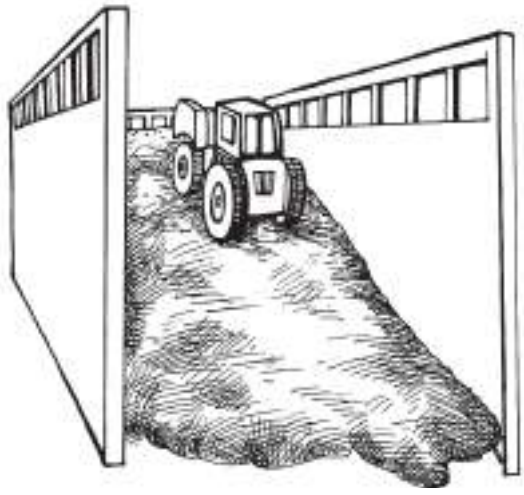


Fig : Silo pit is being filled up with green grasses

c) Crop residue can be preserved 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, kheshari 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 preserved after collection. Rice polish, wheat bran, kheshari bran, oil cake are the by products of rice, wheat, kheshari and black gram, respectively. These by products can be conserved after collection.

e) Feed can be conserved by precessing 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 & Livestock

A. Introduction and importance of supplementary feed for fish

Phytoplankton (microscopic plants), zooplankton (microscopic 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 physical 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 sources should be provided along with natural feed. This is called additional 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 extra feed in the pond. Availability of different nutrients like protein, fat or oil, carbohydrate, mineral, vitamin must have in extra feed as is required. The supplementary feed which is keeping all nutrients prepared in the required level known as balanced supplementary feed.

Source of supplementary feed for fish

Variety of feed ingredients is used to prepare supplementary feed for fish. The ingredients can be divided into two groups on the basis of sources. 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. 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 fingerling, and 3-5% for adult fish. It is necessary to present various nutrients in the fish feed for healthy fish and their rapid bodily growth. Out of these ingredients, protein is important and valuable. It should be available enough in feed. That's why nutrient requirement of fish means mainly their protein requirement. Nutrients 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 fall short. According to species and the different stages of lifecycle, protein requirement will be 20-30% 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 bodily 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.

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

Bodily 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.

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

Name of feed ingredient	Percentage (%)
Fish meal	10-21
Mustard oil cake	45-53
Rice polish	28-30
Vitamin and mineral	0.5-1
Molasses and wheat flour	5
Total	100

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 can be sieved 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.

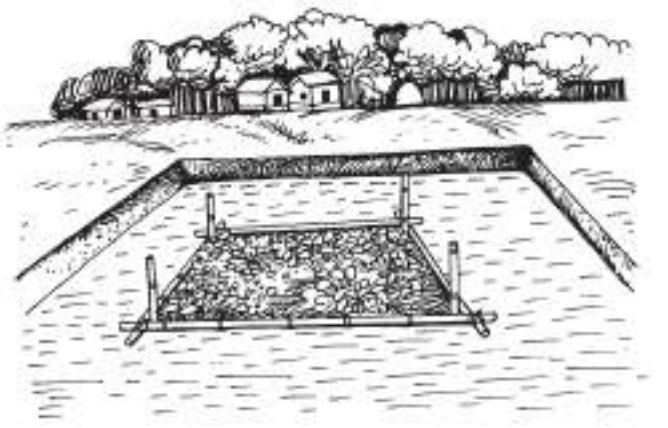
Besides, using the paste, pellet or concentrated feed can be made by native pellet machine easily and economically. In this case, pellet or concentrated feed should be dried up and stored in airtight plastic bag for subsequent use. Some toxic substances are available in oil cakes which are harmful to 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.

Method of application 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 the 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 fingerling and 3-5% for adult fish. Average body weight can be obtained by taking few fishes from the pond through casting net once a week for fry culture and once a fortnight or a month for mixed culturing. Total weight of fish in the pond can be measured 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 bodily 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. Spreading on water dry feed can be supplied. 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 at a certain time. This will ensure the best utilization of feed.
6. As the 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.



Fif: Feeder of tray



Fif: 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).

B. Supplementary 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.



Fif: Wet straw by mixing with urea solution



Fif: Urea solution is being added in straw

Making and using of different supplement feed

A) Urea molasses straw : Using urea in Straw processing-

Ingredients

Straw : 20 Kg,
Urea : 1 Kg,
Water: 20 litre,
A medium size pot, Gunny bag & Thick polythene

Preparation method

1. First, I kg of 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 it is to be dried.
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 to be taken out and conserved after drying in the sun.

Using method

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

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

Ingredients

Wheat bran : 3 kg
Molasses : 6 kg
Urea : 90gm
Salt : 35gm
Edible lime : 500gm
Vitamin mineral premix: 50gm
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 to be slightly condensed by heating in a iron pan.
2. Urea, lime, salt and wheat bran are to be added in the pan after taking out of the heater.
3. Blocks are to be prepared by putting mixed ingredients in the frame just after adding some of bran in it.
4. Blocks are to be conserved in a place free from air and light.

Using method

1. Cattle are to be allowed for licking 300gm block daily.

2. Some of bran and salt are to be added 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 in 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

Algae seed, Artificial shallow pond or water body, Clean and transparent water, Black gram or other pulse bran, Urea

Method of Algae production

1. At first an artificial water body has to be made in a plain and shady place. Water body may be of 3 meter long, 1.2 metre wide and 0.15 metre deep. Its bank may be made of soil or bricks. A transparent polythene sheet containing 3.35 metre long and 1.52 metre 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. 100gm black gram or another pulse bran has to be soaked in 1 litre of water overnight and then water is collected by straining with a picec of cloth.

   In this way, bran can be used at least three times and then supplied to the cattle as feed.
3. Then 200 litre clean tap water, 15-20 litre algae seed and black gram bran mixing water are to be mixed properly in an artificial pond. Then 2-3gm urea is to be added to the pond water and mixed properly.
4. Then algae water is stirred at least three times in every morning, noon and afternoon. Clean water is to be added if the amount of water is reduced. If 1-2gm urea is applied in pond at every 3-4 days interval, it gives 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 litre algae water from a pond of 10 square metre 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. Alage 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 litre can be provided according to the age of calves.

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	Vegetables 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 a 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: According to the age of a calf 0.5 to 3 kg can be fed daily.

Exercise

Multiple Choice Questions:

1. Which type of soil is good for potato production?

a. Loamy soil
b. Sandy loamy soil
c. Silt soil
d. Loamy and sandy loam soil

2. Which is not a herbivorous fish?

a. Kalibaus
b. Mrigel
c. Tilapia
d. Sarpunti

3. To protect seed bags from insect infestation, -

i. Neem leaf powder
ii. Apple seed powder
iii.Orange seed powder

Which of the following is correct?

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

Answer to the questions 4 and 5 by reading th e following stimulus:

Mr. Tasfi was cultivating potatoes on land near a river. Initially, his land produced as expected, but now the yield is declining. He consulted the agriculture officer about this issue. The agriculture officer advised him to create a proper ditch on the sloped part of the land.

4. The reason for the decrease in the yield of Mr. Tasfi's land is ---

i. Decrease in soil fertility
ii. Lack of organic matter
iii.Poor soil structure.

Which of the following is correct?

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

5. Why did the agriculture officer advise Mr. Tasfi to make a Ail on the land?

a. To control soil fertility
b. To prevent soil erosion of the land
c. To increase crop production
d. To improve soil structure.

Short-answer questions:

1. Organic matter is called the life of the soil – explain two reasons for this.
2. What is tillage? How does it help control soil pests?
3. Explain two reasons for differences in land cultivation according to crop type.
4. Explain two reasons for keeping green grass in an airti ght condition while making silage.
5. What is FCR? Why does the quality of fish feed depend on its quality?

Creative Questions:

1. Mr. Shafiq saw a new, improved wheat variety in his friend Rafiq's land and decided to cultivate it. He collected wheat seeds from his friend for cultivation in the next season. To test the moisture content of the seeds, he took 100 grams of wheat seeds and weighed them to get a weight of 90 grams. Then, after testing the germination and freshness, he cultivated the wheat with satisfaction and got the desired yield.

   a. What is soil?
   b. What do you mean by seed germination? Explain it in your own words.
   c. Determine the moisture content of the seeds tested by Mr. Shafiq.
   d. Evaluate Mr. Shafiq's seed testing activity.

2. After completing training with the Department of Fisheries, Mrs. Sabia began fish farming in her pond. She prepared supplementary food and applied it effectively in the pond, successfully boosting fish production. Inspired by her success, other farmers in the area started regularly using supplementary food as well.

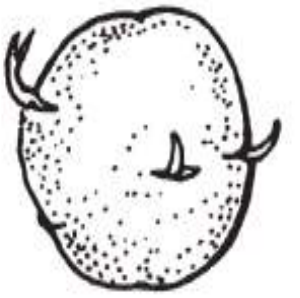
   a. What is supplementary food?
   b. Explain why natural food is not enough in fish farming.
   c. Explain the reasons for Mrs. Sabia's success.
   d. Evaluate the importance of the activities taken by other fish farmers in the area.

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.





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 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 set, 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, 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 :** 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, a farmer must khow the following information.

a) Variety name
b)Name and number of seed grower
c)Percentage of other seed variety
d) Germination capacity of seed
e) Seed moisture content
f)Date of seed testing

Above mentioned pieces of information are written in a guarantee card tag and this card is kept in the seed bag or packet.

4) **Determining seed rate:** Seed rate per hectare is determined considering seed purity, seed viability, germination capacity, seed size, sowing time, soil fertility.

5) **Preparation of the selected land:** Land preparation varies with the crop species and also with the crop variety. For example, for producing seeds of transplant aman rice, land is to be well prepared. On the other hand, to produce wheat seed, land is prepared by 4-5 ploughings in dry condition so that the soil becomes friable. Rate of fertilizer application is also varies with the seed crop.

6) **Seed sowing:** Seeds of the selected crop should be sown in rows maintaining appropriate spacing. The depth of seed sowing in rows depends on the seed size, soil moisture and soil texture.

7) **Roguing:** Although pure seeds are used at the time of seed sowing, some plants of other varieties and weeds are found in the field. These plants are unexpected and are to be removed from the field. Removal of these types of plants is known as"Roguing". Roguing is done at the following three stages:
a) Before flowering b) During flowering c) At maturity.

8) **Intercultural operations:** Intensive and many intercultural operations are needed for seed production. Some of these intercultural operations are cited below:

a) Application balanced fertilizer
b) Manure application
c) Proper irrigation
d) Drainage of excess rain or irrigation water
e) Weeding
f) Disease and insect control
g) Top dressing of fertilizer

9) **Seed harvesting:** Seeds are to be harvested just after ripening. Thereafter, it should be threshed and cleaned.

Steps in production of propagating materials

The most traditional method of seedling production of flowers and fruits in Bangladesh is vegetative method. Because, propagation through true seeds in these plants delayed obtaining flower and fruit and the plant cannot bear maternal characteristics. Besides, in some plants, propagation through true seed is not possible. By vegetative method, using root, stem, leaf, flower, branch etc., rapid production of seedling is possible. For that reason, these are the propagating materials of crop. In some crops like pineapple, banana, potato, zinger, turmeric etc., the propagating materials can be directly planted. On the other hand, in crops like mango, lemon, litchi, rose, propagating materials are at first prepared as layers and thereafter these are planted.

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 'joe' condition by flood irrigation and thereafter seed potato should be planted.

Seed treatment: Seed potato should be treated with boric powder before it germinate (dipping seed potato 15- 20 minutes in 1litre water + 30 gm boric powder 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 gm stable blitching powder or chloropricrin 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, diagnosis of the viral

diseases becomes complex due to lack of any plant nutrient. It is necessary to apply fertilizer for potato cultivation In Bangladesh the fouwing rate can be followed :

Half amount of urea, whole amount of cowdung, TSP, MoP, gypsum, magnesium sulphate, zinc sulphate, boric powder 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	Amount per decimal
Compost manure	40 kg
Urea	1400 gm
TSP	900 gm
MoP	1060 gm
Boric powder/ Boron	25 gm
Zinc sulphate	50 gm
Gypsum	500 gm
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 is to be supplied just after top dressing of urea. Because within 30 days stolons are started to be developed. Generally, 2/3 portion of the ridge is to be wet by water.

Weeding: Up to 60 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 'Joe' 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 gets 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 according to recommended rate.

(c) Aphid: Aphid sucks juice of plants and spreads viral diseases. It is very urgent to control aphid for the production of potato seed. For this 7-10 days later leaves are grown in the plant and then recommended insecticides should be applied for controlling aphid. It is better to harvest potato within 70-80 days for the avoidance of aphid's attack.

Crop harvesting and taking 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) Harvasting potato: It is best to bring the potato tuber home just after lifting. Potato tuber must not be kept in the field making heap after hervesting. 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 hervesting. 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 that are produced from seed must be saved by preserving their seeds. 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, it takes time to get yield. 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, core characteristics of the original are maintained. More 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 maintain and also they yield high production.

Characteristics of an ideal pond

Fish pond should have some characteristics which can play role to make fish 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 metre.
5. It would be better if the pond is in open place and having no trees on the bank. Thus, the pond will get sufficient light and air and, more photosynthesis will occurr 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 slope down at 1:2 ratio. Therefore, height between the bottom and the bank of the pond will be doubled.

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 cultue are given below in short :

1. Physical properties

a. Depth: If the pond depth is more, sunlight cannot enter through the pond water at the deeper level. As a result, in deep area of pond, phytoplankton which is the natural food of the fishes can not grow. 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. 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 water becomes turbid by mud particle in the pond, sunlight can not pass through. As a result, natural production of food of the fishes is greatly disturbed.

d. Sunlight: More photosynthesis occurs in the pond where sunlight is more. As a result, phytoplankton grows more and fish production is on the increase.

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, is 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. P^H : The range of acidity and alkalinity can be understood by identifying value of P^H of the pond water. It is better for fish culture if P^H value of pond water ranges between 6.5 and 8.5. If the value of P^H is lower than 4 or higher than 11, fishes die. If P^H value decreases and acidity increases in water, lime should be applied in the pond (1-2kg/decimal). If P^H value increases and alkalinity increases to higher level in the pond water, ammonium sulfate or tamarind mixed water can be applied.

d. Phosphorus: There is a little amount of phosphorus in natural water. This phosphorus turns into phosphate. A lot of phytoplankton grows in presence of required amount of phosphate.

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 also be cultivated as mixed culture in these pond.

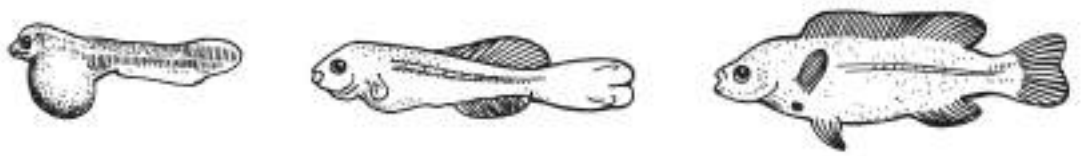
B) Temporary or seasonal pond: In these ponds water is available for a specific period of a year (3-8 months). These ponds are not so deep. Soils of these ponds cannot hold water for more time as a pond of sandy soil can. In these ponds, fast growing fishes which are suitable for marketing in less than a year can be cultured, for example, silver carp, telapia, 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 such as 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 and assumes the shape of rice grain (like 2 or more than 2cm.), is called dhani fry and when it grows longer as a finger (more than 7 cm.) it 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 50-100gm renu fries are released per decimal and cultured for 15-30 days.



Yolk sac larvae, Dhani fry, Fingerling

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 metres. In this pond, dhani fries can be cultured for 2-3 months after releasing 2500-4000 fries per decimal.

C) Stock 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 metres. Generally, fish should not be cultured here more than a year because growth rate becomes slower even after providing 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 are available in this layer. Rui fish lives and takes foods in this layer.

3) **Bottom Layer:** In this layer, are dissolved oxygen and temperature at the lowest level. 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 telapia. On the other hand, grass carp takes green plants as food growing on surface, bank or at the bottom of the pond.

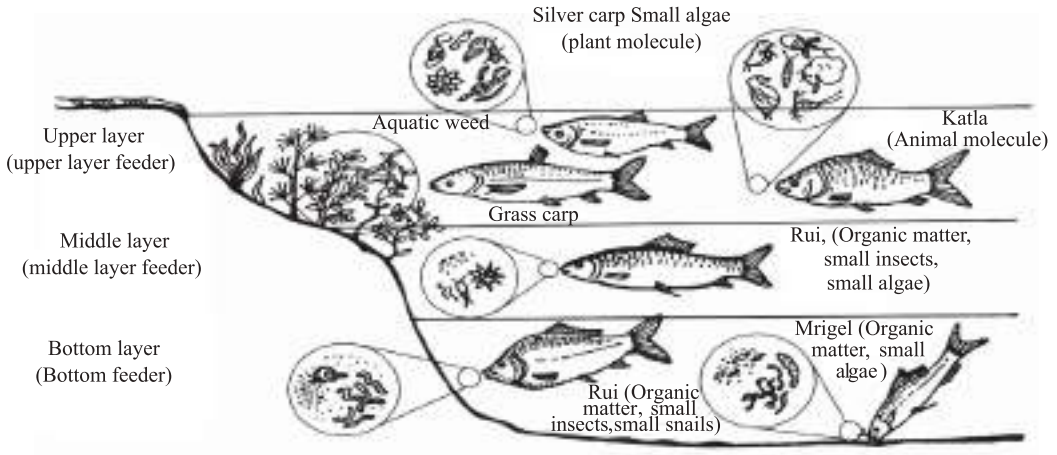


Fig. Different layers of pond

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, 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 take food searching like fish, frog etc. although the traits of their egg and larva are as like as planktons.

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.

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.



Fig: Water hyacinth

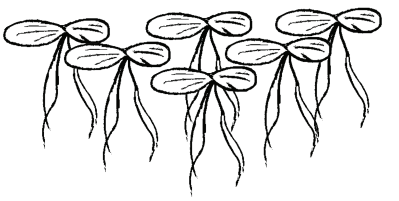


Fig: Khudi hyacinth

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 etc.



Fig. Water lily



Fig. Lotus

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 etc.



Fig. Leafy Jhanjhi



Fig. Najas



Fig. Throny jhanjhi

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 etc.



Fig. Maloncho

Section-3

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: A pond should be dug maintaining more or less those characteristics which make an ideal pond. The pond should be dug more or less rectangular. The pond depth should be maintained as if it contains water up to 1.5 to 2 metres throughout the 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 damage the pond bank within a few days. If soil is well and fertile, it would be kept separate 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 metre. Space should be given between upper surfaced layer and bank. This place is called bokchor. The bottom of the pond will be level but should be kept slightly slant. It will make irrigation and fish collection easy. After digging of new pond, the soil of the bank should be made compact by beating with a roller and grass should be cultivated on bank. This reduces the breaking of the bank and the soil will not be eroded in rainy season.

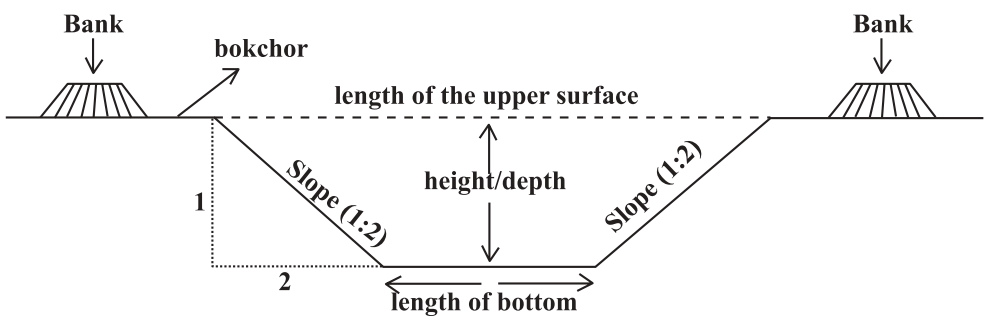


Fig. Cross section of a pond

B. Pond preparation or making suitable for fish cultivation

Pond preparation is very important for fish culture. Before fish cultivation, if existing 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 on the bank or if there in any 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 keeping only 20-25cm of it. It can be done easily by drying up the pond. Fish pond should be dried up once in every 3-4 years. 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 slanted. This facilitates pulling net and collecting fish.

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 checked 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 and shwarpunti are herbivorous fish. By releasing these fishes at the cultivation period, needs can be checked 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 the 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 of suffocation. 30-35gm. 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 are 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 P^H of water.
3. Reduces 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 P^H 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 P^H value of the soil are given below:

Doses of lime application during pond preparation

P^H 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: Fertilizer application produces natural food for fish in the water. The main natural food of the fishes are phytoplankton and zooplankton. Different nutrient 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 is 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, MoP 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	8-10 kg	MoP	20g

6. Testing Natural Feed: Before stocking fries in the pond, testing should be done whether natural feed 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 30cm 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, it should be understood that there are optimum food.

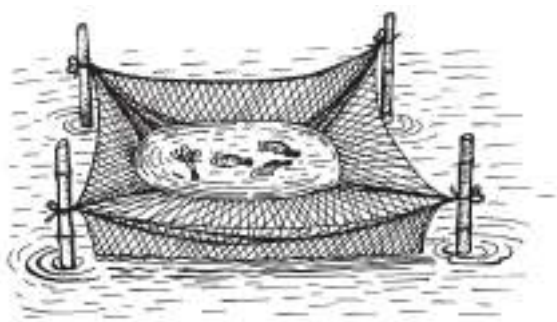
c. **Testing with glass:** Taking pond water in a transparent glass and holding it against the sunlight, and if the green or brownish green water or many small particles and small insects can be seen, it is to be understood that there are optimum natural foods.

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.

Method of releasing 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 move 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 of 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 parmenganate 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 present it after visiting pond/ fish farm.

Scetion-4
Sanctuary of Fishes

There are various types of small and big internal water bodies in the riverine country of our Bangladesh. The area of water bed is about 47 lac hectare and moreover, it has immense Bay of Bengal of 118813 square kilometers. Among the water bodies in Bangladesh, 82 percent is free water body like- river, beel, water body of Sundarbans, kaptai lake, haor, tidal area containing 38.90 lac hectare area. On the other hand, closed water bodies are only 18 percent, among which pond, lake, ditch, haor and shrimp farm. The total area of these is 8.15 lac hectare. Presently in Bangladesh, 85 percent of total fish production comes from internal water bodies, 15 percent fish comes from sea.

In the distance 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 the 60s. The production from internal water body has come down to 28% 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 57% production comes from the fishes cultured in different closed water bodies and 15% 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, 9 critically endangered, 28 endangered and 30 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 breed 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 extended.
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.



Fig: Fish sanctuary

Task: Learners will prepare a report on the importance of establishment of fish sanctuary.

New words: Critically endangered species, 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. To meet the increasing demand, the fishermen are fishing almost all fishes of various sizes from 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 revised in different times to meet the need. The remarkable ordinances of this law are-

1. Without the view of cultivation, every year- **a)** from July to December (mid Ashar to mid Poush) the katla, rui, mrigel, kalabaush, ghania fishes below 23 cm (9 inch) in size; **b)** from November to May (mid Kartik to mid Jaistho) hilsha fish below 23 cm in size (which is known as jatka); **c)** from November to April (mid Kartik to mid Baishakh), pangash fish below 23cm (9 inch) in size;**d)** from February to June (mid Magh to mid Ashar), sylon, boal and air fish less than 30cm (12 inch) in size are prohibited to catch, possess, transport and sell by anybody.
2. Without the view of cultivation, every year from 1st April to 31st August (mid Chaitro-mid Bhadro), no steps can be taken for fishing or destroying the fries or mother fish of shoal, gajar, taki in the water bodies connected with rivers, canals, and 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 installation (fixed engine) making in rivers, canals. In this case, permanent installation 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 4.5cm or less diameter or length is prohibited to be used.

7. **Conservation of hilsha sanctuary:** In government announced hilsha sanctuary area, and in the fixed time of the year nobody can catch or create the cause for catching fish.

8. **Conservation hilsha fish in their breeding place:** To give the free breeding opportunity in the breeding area every year from 13 October to 3 November, catching of hilsha fish is prohibited.

9. **Punnishment: a)** For the 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 Net

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, such as-

1. To make comfortable environment.
2. To manage properly.
3. For intensive care.
4. To prevent from bad weather.
5. To supply feed and water easily.
6. To prevent and control of poultry disease.
7. For easy vaccination.
8. To protect from wild animals.
9. To protect from thief.
10. To collect egg easily.
11. For cleaning litter easily.
12. To require less labour.

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

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.

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

1. 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

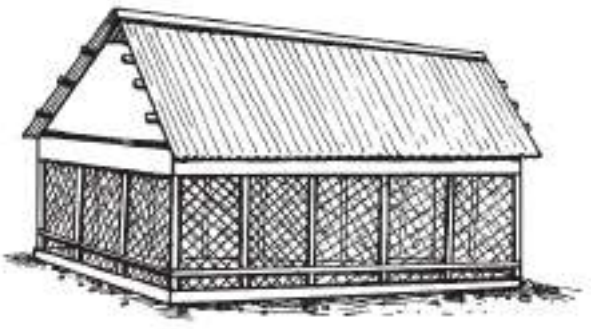


Fig: Gable type house

2. Gable type: Gable type or double roofed house requires more cost for making. Roof of this type of house is slanted. Gable type of 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, littre, 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 house: Hatchery house 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 conditions 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 metre (1 foot) for broiler and 0.6 metre (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	Slant method
from 1st day to aged bird	0.05-0.28 m^2	0.02-0.07 m^2	0.02-0.19 m^2

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 micro-organisms, 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 intake of 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 (gm/day)	Broiler (gm/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.

Mixture of different feed ingredients for layer chicken

Ingredients	Percentage (%)
Wheat/ broken corn	45-55
Wheat bran	8-12
Rice polish	10-15
Sesame oil cake	10-15
Fish meal	10-12
Bone meal and oyster shell	1.5-7
Salt	0.5

Special note

1. **Vitamin-mineral premix:** It should be added in feed as per manufacturer recommendation.
2. **Organisms free pure water:** Ad libitum (as desired).

Feed chart for broiler chicken of different ages

Ingredients	Starter ration (%)	Grower ration (%)
Broken wheat/corn	50	52
Broken rice	14	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 prepare 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:** Ad libitum (as desired).

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 the first few weeks to train 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 of Duck	Quantity (gm/day)
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	Ingredients percentage (%)
Broken corn	45-50
Rice polish	10-15
Oil cake	10-15
Soybean meal	8-10
Fish meal	8-10
Snail shell	1.5-6.5
Common salt	0.5

Task: How much an aged duck will feed in 20 weeks will be prepared by the learners and they will present it in the class.

Section-8
Livestock Feed

Animal essentially requires feed to be alive. The substance which by animals eat as daily intake and is digested, absorbed, utilized in body through metabolism and produces 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 of 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 a long time.
2. Can be supplied 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 milch-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 plant. 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 airtight pits for a long time. But nowadays, these are preserved in large sized polythene bags instead of pits. The openings of the bag are made airtight 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 airtight during silage preparation

1. Higher amount of sugar can be released for fermentation.
2. For proper fermentation, necessary lactic acid can be synthesized under airtight 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 airtight 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. Hay 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 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

Multiple Choice Questions:

1. Which potato disease causes severe damage?

a. Potato blight b. Wilting diseases
c. Stem rot d. Viral diseases

2. What is the minimum dissolved oxygen content in pond water?

a.2 mg/liter b. 3 mg/liter
c. 5 mg/liter d. 7 mg/liter

3. Potato blight occurs –

i. At low temperatures
ii. In dense fog
iii. During excessive rainfall

Which 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 stem and answer questions 4 and 5:

Farida Begum prepared the acidic soil pond on the southern side of her 15-decimal homestead for fish farming. She applied fertilizer and lime to the pond based on estimation. Later, without proper training, she released fries, only to find that most of them died.

4. How much lime should Farida Begum apply to her pond?

a. 20 kg b. 25 kg
c. 30 kg d. 35 kg

5. The reasons behind the death of the fries in the pond are—

i. Difference in water temperature
ii. Unfavorable pH level of the water
iii. Variation in oxygen levels

Which of the following is correct?

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

Short-answer questions:

1. What is rogueing? At what stage of seed crop production is rogueing done?
2. What is potato hum-pulling? Why is it done?
3. It is better not to use chemical fertilizers in seedbeds - explain.
4. What is meant by a fish sanctuary?
5. What type of chicken farm is best to make quick profits? Explain.

Creative Questions:

1. Abul Kashem has established pasture land for raising animals. While his pasture land produces a substantial amount of grass during the rainy season, he is unable to satisfy the demand for grass during the dry season. As a result, he made arrangements for the proper storage of green grass to ensure his animals have the necessary food year-round. Consequently, Abul Kashem inspired many of his neighbors to store cow fodder in this manner.

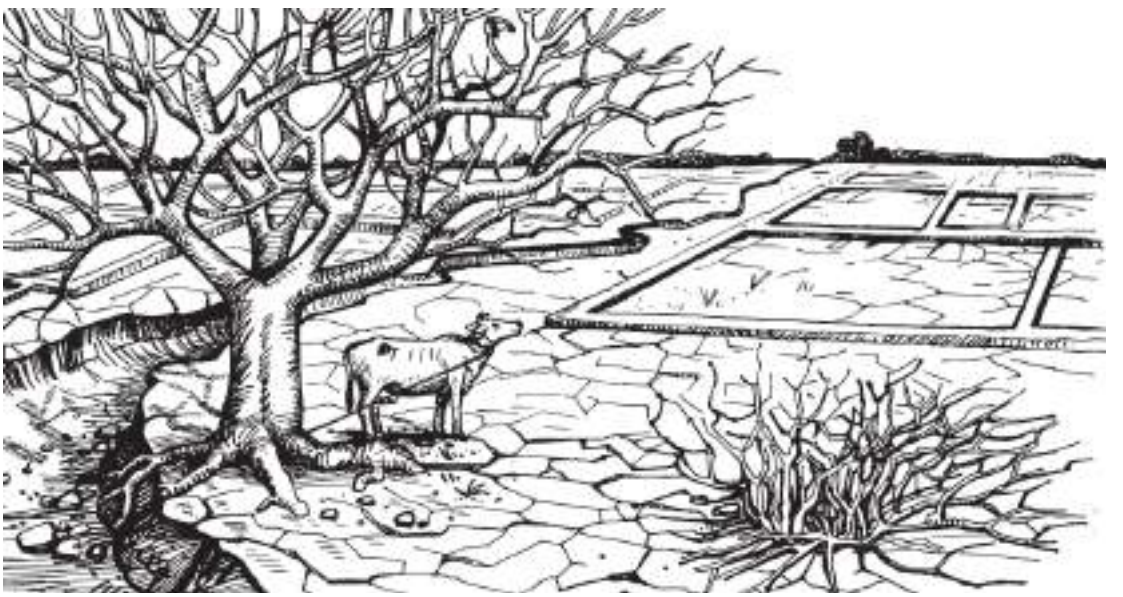
   a. What is cow fodder?
   b. Explain how grain feed increases animal production.
   c. Explain the strategy behind the method adopted by Abul Kashem.
   d. Evaluate Abul Kashem's activity.

2. Young man Mohibullah decided to start fish farming after taking training at the Bogra Rural Development Academy. He renovated 50 percent of his pond and prepared it for carp farming. After applying the necessary fertilizer, he stocked the pond with fish fry. Following the stocking, he tested the pond's natural food using a Secchi disk and added the essential fertilizer. Currently, he is recognized in the area as a successful fish farmer.

   a. How much dissolved oxygen is required per liter of pond water for fish farming?
   b. Explain how lime increases the quality of water.
   c. Calculate how much cow dung Mohibullah used during the preparation of his pond.
   d. Analyze whether applying fertilizer to Mohibullah's pond helps prevent wasting money and increases production.

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 of mechanisms to 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 an 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 temperature in winter exists in January. In winter the highest average temperature is 29^{o}C. And the lowest average temperature is 11^{o}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^{o}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. BRRI dhan 36 and BRRI dhan 55 are cool tolerant type of rice. Among them the characteristics of one type rice are described below:

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 tolerant of 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 a long period of time eg; for 20 days or more in dry season when there is little or no rain 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 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

Among BRRI dhan 56, BRRI dhan 57, BRRI dhan 76, BRRI dhan 96, BRRI dhan 97 and BRRI dhan 105, the characteristics of BRRI dhan 57 are described.

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 reduce 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 4.0-4.5tons 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 32, BARI wheat 20 (Gourab) and BARI wheat 24 (Prodip) are drought tolerant type of wheat. Among them the characteristics of BARI wheat 24 (Prodip) are described.

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.

Ishwardi 35: The average yield of this type is 94 tons per hectare. Among the other drought tolerant sugarcane varieties there are Ishwardi 33, 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 colour. 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 & BARI hybrid tomato-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:

Highly tolerant to salinity	Moderately tolerant to salinity	Susceptible to salinity
Coconut	Sweet potato	Bean
Betel nut	Pepper	Lemon
Pulm	Chili	Orange
Barley	Cowpea	Carrot
Date	Mung bean	Onion
Sugar beat	Grass pea	Strawberry
Turnip	Pea	Lentil
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- Rajashail, Kajalshail, Bajail, Kalamanik, Garcha, Gabura etc. In

the mean time Bangladesh Rice Research Institute has developed many salinity tolerant rice varieties. For example-BRRI dhan 40, BRRI dhan 41, BRRI dhan 47, BRRI dhan 53, BRRI dhan 54, BRRI 67, BRRI 78, BRRI 97 and BINA dhan 8. The main characteristics of these two varieties have been described below:

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.

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): The potato of this variety is long- round and red in colour. Yield of this variety is 25-30 tons per hectare.

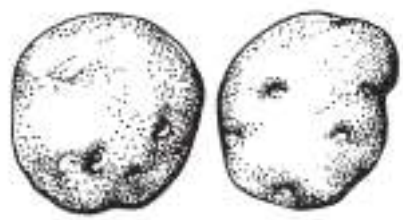


Figure : BARI alu 22

BARI misti alu 6 and 7: The skin colour of these two sweet potato varieties is deep orange and their inside colour 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.

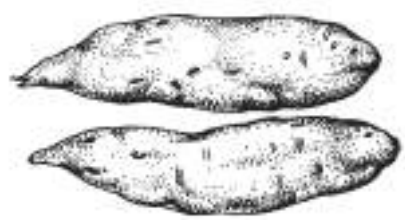


Figure : BARI misti alu 6

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 and Ishwardi 40 are salinity tolerant variety of sugarcare. Among them the characteristics of Ishwardi 40 are described.

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. 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 simultaneously 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 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 recently developed two varieties of rice of aman season for cultivating in these regions are-

BRRI dhan 51 and BRRI dhan 52: This variety is released in 2010 to cultivate under flash flood- prone areas in aman season. If one week after transplanting, the seedlings of these two varieties become submerged for 10-14days, seedlings do not die. For that reason, yield is not reduced. The life cycle of this variety is 140-145days and yield is 4.5-5.0 tons per hectare under flood free condition; whereas, life cycle is 155-160days and yield is 4.0-5.0tons 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, Ishwardi 36, Ishwardi 37, Ishwardi 39, Ishwardi 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. Nowadays, Bangladesh is identified as the most affected and hazardous country in the world. According to the 2021 report of the United Nations Development Programme (UNDP),due to climate change 13.3 million (1 crore 33 lakh) people in Bangladesh can be internally displaced by 2050. 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 NAP(National Adaptation Plan of Bangladesh) that due to climate change-

1. The average annual temperature of Bangladesh has gradually increased every year.
2. Salinity has been found in the 10 lac 56 thousand hectares of land in Bangladesh.
3. Average rainfall has increased in Bangladesh. There were floods in 2002, 2003, 2004, 2007,2009,2017,2020 and 2024 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 landslide.
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 2^{o}C 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 35^{o}C. Flowering stage is the most sensitive for rice. At this stage, if the temperature remains at 35^{o}C or more, unfilled rice grains will be filled. Low temperature hampers normal growth of rice plant, turns rice plants yellowish, makes rice seedlings weaker and longer the life cycle of rice crop.

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. 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 into 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 north-western regions of the country. Rajshahi, Chapainawabghanj, 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. 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.

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

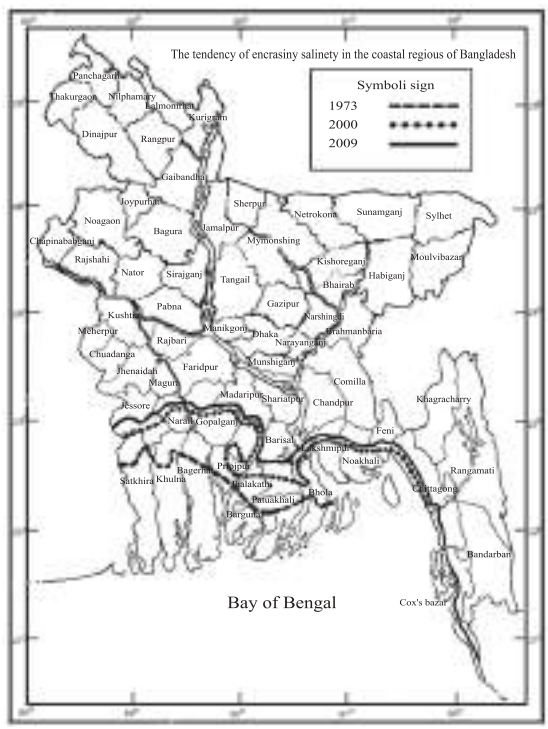
Influence of salinity is found in coastal soil of Bangladesh. Due to cyclone, seashore, and severe tidal flood, saline water directly enters the land, thereby salt content is increased in soil. Again, in dry season, underground salt lifted upward through evaporation of soil water. Consequently it hampers soil fertility. At present the amount of land affected by salinily 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.

Some areas of Satkhira, Patuakhali, Barguna, Barishal, Jhalokathi, Pirojpur, Jashore, 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 higher of temperature and lowere of rainfall due to climate change. Due to the increase of world temperature, the sea level is on the rise 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 cause 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 stagnancy of water 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 flood caused by cyclone and tidal surge cause a large damage in the coastal regions. Stagnancy by saline water is created in the land. Consequently, due to stagnancy and salinity, it creates the environment unfavorable to crop production. The districts of Cox's Bazar, Chattogram, 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 kilometre area of north-eastern regions and one thousand four hundred square kilometre area of the south-eastern regions of the country are such type of excessive rainfall-prone areas.

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 is a good example of submergence.

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, kahrif- 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 developed various crop varieties which are suitable for cultivation 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

Previous to this we have learnt about drought. 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 types of crops of which life cycle is short. 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 fallon requires 17-20days for flowering to maturity. Therefore, by cultivating fallon 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 of crop stores adequate amount of solution 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 wilt, if the cell water is less in leaf.
3. **Starvation:** Some plants diminish their rate of photosynthesis under drought condition. In this condition although the leaf cells become wilted, the guard cells deposited various solution in the cells and maintain turgor pressure, allowing entrance lower amount of carbon dioxide to continue limited photosynthesis. Thus, plants just survive under drought.
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 drought.
6. **Dormancy:** Parts above ground 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 hole (sunken stomata). Therefore, transpiration becomes lower and thus water is conserved.
2. **Control of transpiration:** Many plants deposit lipid on the upper surface of the leaves and lower the transpiration rate when they are under drought such as-soyabean. Again many plants make a layer on the upper leaf surface by wax or dense hair to lower transpiration.
3. **Decreasing leaf size:** Many plants lower transpiration under drought condition by decreasing leaf size; such as fallon. 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.
5. **Increasing photosynthetic efficiency:** Although some plants lower transpiration by controlling stomata, they photosynthesize more by receving 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 more depth and density of root are present in an single crop, this crop becomes more tolerant to drought; such as- Jower and Bajra (different kinds of millet). Again, Dhaincha, Cotton, 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 without 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, wastage of water is low, and they adapt to 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 fallon 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 cannot 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 of 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 vacauole, 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 of 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 lac 66 thousand square kilometre. Presently, fish production from these water bodies is not sufficient as compared with its area. More production can be possible from them. In 2011-2012 fish production in Bangladesh was about 32.62 lac metric ton and target production is 45.50 lac metric ton up to the year of 2020-2021. Although, fish production in this country has gradually been increased for last few years, 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 an 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 on the increase. 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 releasing fries becomes late. Besides, pond is also dried out quickly after the fries are released late. As a result, culturing period is reducing and small fishes are to be marketed before reaching their maturity. In this way, farmers are lossing.
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 fishes 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 affecting 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 go under water 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 becomes easy 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 hampered.
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 and baor and tidal area of our country, April-May is the breeding period of native type small fish. In the recent years, water bodies do not go under water till 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 in 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, incompatibility 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 fishes

1. Carbon dioxide 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 increase in one part of ocean. Where as, 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 occur 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 in the Perspective of Climate Change

It is important to overcome the negative impact of climate change on fish biodiversity and production. Otherwise, environmental balance will be destroyed, and our food security will be seriously threatened. We need to take steps to adapt to 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, steps should be taken to produce saline tolerant fish and fries like vetki, bata, parshe etc.
2. The water body where salinity is increasing, shrimp and crab can be cultivated.
3. Drought prone area where there is low rainfall, big fries can be cultivated in the temporary water. For this reason, big fries should be stocked in the locality.

   Telapia is much more drought tolerant fish. Koi (climbing perch) and deshi magur (indigenous cat fish) can also be cultivated in drought prone regions.
4. In flood prone areas or where there is more rainfall, the banks of the pond should be raised or surrounded by net so that flood water cannot enter into pond or pond fishes cannot 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 there is flood 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. It is due to gradually increase of increasing temperature of the environment, temperature tolerant fish cultivation and production of their fries can be carried out, for example: Magur, Rui, Shing (stinging catfish).

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 warmth. For maintaining same purpose, some creeper plants can be given opportunity for grow on water nearer to the bank of the pond.

10. Roaming area for sea fish is changing due to climatic changes. Consequently new movement areas would be identified so that no negative influence falls on fishing and livelihood of the fishermen. For this modern research and survey can be conducted and used.

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 hit 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 to 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 prevails 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 Chattogram 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 large scale. These are long term permanent system. If steps are taken for implementation of these matters, livestock of our country 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

- Scarcity of green grass.
- Water is polluted.
- Cattle suffer from malnutrition.
- Cattle are affected by different diseases.
- Dryness of field grasses.

- External parasitic infection increases on the animal body.
- Excessive heat creates intolerable situation for birds.
- Reducing the health condition including chances of death.
- Heat stress causes death of broiler and layer.

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

- Water logging is created.
- Maximum areas of country go under water.
- Outbreak of diseases.
- Cattle feed is not available.
- Water is polluted.
- Problem in maintaining livestock is created.
- Cattle suffer from malnutrition.
- Infestation of different infectious disease and attack of worms are increased.
- Toxicity generates in grasses, cattle become sick.
- Environment becomes unhygienic, many animals die.

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

- Water is polluted in tidal wave affected area.
- Many livestock and animals die immediately after tidal wave and storm.
- Dead birds pollute environment in want of burial.
- Scarcity of animal feed.
- Due to affection of diarrhoea, stomach illness, and bloating many animals die.

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.

Human being can protect themselves by their knowledge if suddenly massive climatic change occurs, but livestock and poultry cannot adapt in such a situation. Livestock and poultry are helpless and gentle animal. Many of them are able to adapt with the environment if the climate changes is occurred slowly. Many species may also extinct due to inability to adapt to environment. Peoples' help is required for animal adaptation in unfavourable and adverse environment. More emphasis should be given to solve 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. Supplementary feed of green grass (like- green algae) should be the fed to cattle.
5. Silage and hay should be prepared before coming of drought so that these can be provided to livestock during drought.

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.



Fig: Cattle intake ipil ipil tree leaves during drought.

12. Treatment for sick animal should be carried out according to doctor's suggestion.

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 cannot 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 flood water goes down .
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

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. Vast sea-coastal area and islands of our country are affected by the tidal waves. So, following works should be carried out to protect livestock from devouring 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 may not be affected by disease after taking rotten and polluted water.

Exercise

Multiple Choice Question

1. What are the prerequisites for crop production in adverse conditions?

a. Selection of suitable crops b. Selection of the correct land
c. Proper maintenance d. Application of more fertilizer

2. Which is the popular variety of Aman planted in Khulna and Bagerhat regions?

a. Balam b. Dishari
c. Chandina d. Mukta

3. Due to climate change, the crop production of our country will face –

i.Diseases and pests will increase.
ii.The amount of organic matter will increase
iii.Soil fertility will decrease

Which of the following is correct?

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

4. Which plant is a halophyte?

a. Bean b. Cotton
c. Keora d. Bine

Read the following stimulus and answer questions 5 and 6:

Taher Mia's home is in the Netrokona district. During the early stage of paddy growth in the Aman season, the paddy remains submerged for 10 to 15 days, resulting in a lower expected yield. Additionally, the mature Boro paddy is often flooded in the hilly regions.

5. Which variety of paddy will Taher Mia cultivate in the Aman season to obtain the expected yield?

a.Kiran (BR 22) b. BRRI Dhan 51
c. BRRI Dhan 45 d. BRRI Dhan 36

6. To prevent the ripe paddy from being wasted in the Boro season, Taher Mia should –

i. Plant seedlings at the right time
ii. Use BRRI Dhan 28 and BRRI Dhan 45 varieties
iii.Use of BRRI Dhan 51 and BRRI Dhan 45 varieties

Which of the following is correct?

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

Short-answer questions:

1. Explain one reason why the salinity of freshwater is increasing due to climate change.
2. How can flood damage be reduced by selecting waterlogging-tolerant rice varieties?
3. What is proline? How does it make crops drought-tolerant?
4. What are halophytes and glycophytes? Give examples of these.
5. Explain two harmful aspects of increasing greenhouse gases in the atmosphere.

Creative Questions

1. Atiqur Rahman's home is in the coastal Satkhira district. He struggled to produce crops by cultivating local varieties of rice on cultivable land. Following the advice of an agriculture officer, he decided to cultivate rice-8, encountering no issues. One day, after viewing the informative pictures displayed by the Department of Agricultural Extension, Atiqur Rahman learned a great deal about cultivating various crops that are resistant to salinity.
   A. What are salt-tolerant crops?
   B. How does temperature hinder agricultural production? Explain.
   C. Explain whether Atiqur Rahman's decision is correct or not.
   D. Evaluate the activities of the Department of Agricultural Extension in Atiqur Rahman's area.

2. Wajiha's father regularly collected fish eggs from the Halda River in Chittagong and sold them. However, this year, he looked up at the sky, sighed, and stated that it would not be possible to collect carp eggs at the specified time. As a result, his income and livelihood would decrease. He learned the reason for the decline in fish resources through the procession and informational images during Fisheries Week in the area.
   a. What is the weather?
   b. Explain one harmful aspect of adverse environmental reactions.
   c. Explain why Wajiha's father could not collect eggs.
   d. Analyze how the procession mentioned in the stimulus will impact the increase in 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 ways. 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 our country. Therefore, it is essential to have knowledge about agricultural productions.



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

- learn the names of the various crop suitable for cultivation, their production technique, pest management and explain their economic importance;
- learn about techniques of vegetable production, its pests and their control methods and can explain the economic importance of vegetable cultivation;
- learn about cultivation technique of various flowers and fruits, its 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 housing for livestock and poultry raising, identification of diseases and their management in cattle caring and 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 fish culture technique and describe the systems of integrated culture 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, Latishail.

b) **Local improved varieties:** Kataktara, Kalizira, Hasikalmi, Nizershail, Latishail, 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:

- Plants are stout and leaves are erect.
- Plants remain green although the rice grains of panicles become ripened.
- Plants are short and cannot be lodged.
- Production or rice grain is higher than that of straw.
- Insect and disease infestation is lower.
- A large number of shoots sprout.
- 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 is not modern rice, but all modern rice is HYV.

Bangladesh Rice Research Institute (BRRI) has developed 113 HYV and 8 hybried 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 3 (Biplob) 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 13 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 45 varieties that are cultivated only in aman season. Some of these are BR 5 (Dulavog), BR 11 (Mukta), BR 22 (Kiron), BRRI dhan 56, BRRI dhan 57 and BRRI dhan 62 etc.

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

c) **Boro varieties:** There are 34 varieties that are cultivated only in boro season. Some of these are BR 18 (Shahjalal), BRRI dhan 28, BRRI dhan 29, BRRI dhan 45, BRRI dhan 50 (Banglamoti), BRRI hybrid dhan 1, BRRI hybrid dhan 2, BRRI hybrid dhan 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 gm 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 by 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, dipping seeds in warm water of 52-55^{o}C (hand tolerable) for 15 minutes can be made the seeds free from pathogens. Besides, seed treatment can be done by Carboxin 17.5% + Thiram 17.5% 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 harrowing. 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 excluding drain the size it 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.

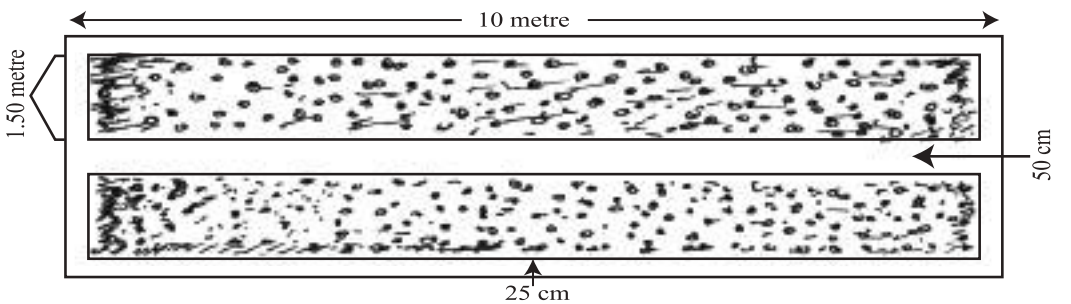


Fig. . Layout of rice seed bed in one decimal land.

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 harrowing. 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 harrowing. 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: Immediately after sowing, protective measures must be taken against poultry, birds, live stocks etc. for 4-5 days. Measures should be taken to keep water in the drain between the two beds so that beds do not become dry. Thereafter, appropriate irrigation of water should be applied to the beds from the drains. The weeds, if grown in the seed bed, should be removed. Proper measures should be taken against the diseases and insects in accordance with the suggestions of the agriculture officer. If the seedlings in the seed bed become yellowish, 7 gm urea per square meter of seed bed should be applied. 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 gm gypsum per square meter of seed bed should be applied by top dressing. The seedlings may be injured due to excessive cold. 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. This makes the seed soil soften. Consequently, the uprooting of seedlings becomes easier.
2. Insecticides 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 previous crop residues and weeds in the field should be removed. To make the soil loose and friable, it should be thoroughly ploughed 4-5 times using a country plough or power tiller, depending on the soil type. To make the soil soft and even, little ploughing and leveling are recommended. Field bunds should be trimmed 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, MoP, 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. after growing 4-5 tillers and the last installment after 45-50 days of transplanting i.e., 5-7 days before booting stage.

The quantity of organic fertilizer, urea, TSP, MoP, gypsum and zinc per decimal are shown below:

Name of fertilizer	Quantity
Compost fertilizer	20 Kg
Urea	360-840 gm
TSP	300-500 gm
MoP	160-280 gm
Gypsum	240-280 gm
Zinc	40 gm

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 require 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, MoP and gypsum at recommended doses, the existing crop requires half amount of recommended doses of these fertilizers.
6. MoP 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 manuring 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 filed. 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 filed. These should be controlled directly by hand/ khurpi 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 borrer moth



Fig: Rice hispa



Fig: Rice bug

The insect can be controlled by applying insecticides based on symptoms of infestation as described in the table below:

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 eat 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 colour, 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	Chloropyriphoj 50 or Malathion 57 EC or Fenitrothion or Diazinon 60 EC
Brown plant hopper	Carbofuran 3G/10 G 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	1) Oval spots appear on the leaf 2) Surroundings of the spots become deep brown and the centre becomes ash colour. 3. When many spots are mixed, then leaves die.	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	1) Tungro disease may appear within one month 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 spreads to the surrounding bunch gradually.	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 preservating

The crop will have to cut whenever the rice grains become ripen in the panicle. If the crop is harvested at over maturity, many rice grains are shattered, the panicle breaks, may be 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 leaving them in the field. During threshing on katcha threshing floor, chatai, chot or polythene have to be broadened on the floor. The colour of rice grain remains bright and clean on threshing rice in such a 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 has to be preserved be filled well. During preservation, if neem/ nisinda/ bishkatali leaf (dust) are mixed, the insect infestation becomes 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, colour), 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 (Joe jute), D-154, Atom pat-38 etc. are the varieties of deshi jute.

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

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

Variety of mesta: HS-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 harrowing. 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 will not be up to the expectation.

Fertilizer application: Jute yield can be easily increased by applying appropriate amount of organic and chemical fertilizer at appropriate time. If organic fertilizer is applied in due 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 khurpi. Then, 200 gm urea per decimal should be applied for all jute varieties except O-9897 and 400 kg urea per decimal 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 khurpi. 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 trteatment should be done by mixing 20 gm Redomel 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 7-10cm 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 'Joe' or suitable condition in soil.

Cultural operations after seed sowing

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

Irrigation and drainage: Water should be supplied during drought condition and excess water should be drained out if there is stagnant water.

Insect control: Jute hairy caterpillar, mole cricket, jute weevil, jute semilooper, mites etc. 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

- The leaves with eggs should be removed and damaged whenever found.
- At the early stage of infestation when the larvae remain in group the leaf with insects should be killed pressing by legs,putting in pit or by dipping in kerosene mix water.

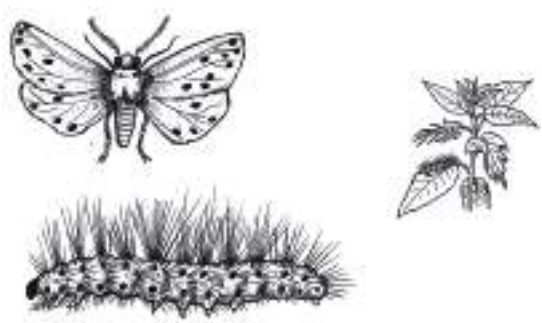


Fig. : Jute hairy caterpillar and jute plant

- The pupae under the soil come out whenever the dry land is ploughed after cutting jute and these pupae are damaged by birds.
- 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.
- The insecticides should be applied at recomended dose.

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 field 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

- The land in which the infestation is higher each year, the seed rate should be higher for that land.
- In the infested land, when the seedlings become 8-9 cm, densely populated plants should be thinned out.
- If possible, measures should be taken to supply irrigation from the nearby water source.
- Measures should be taken to apply insecticides at recommended dose.
- Insecticides should be applied in the holes.
- Poison baits of insecticides should be applied.

c) Jute semilooper: Symtoms : 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.

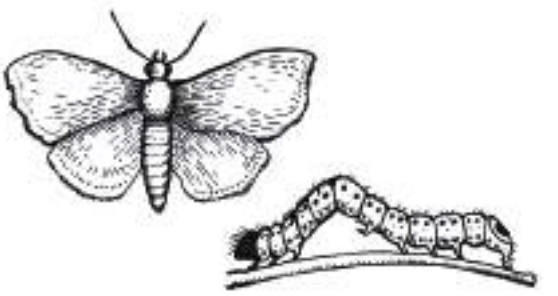


Fig. : Jute semilooper

Control measures

- When infestation is found, kerosene mixed rope should be pulled over the jute plants. This will reduce the infestation of the insects.
- 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.
- Insecticides should be applied at recommended dose.

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 die and 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 rotting, these knots do not undergo rotting. The fiber bears black spots on that places and thereby the fiber quality deteriorates and price is reduced.



Fig. : Jute weevil

Control measures

- The weeds near the jute field should be cleaned before seed sowing and after cutting of jute.
- The infested jute plants should be removed and be destroyed.
- The insecticides should be applied at recommended dose when 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 colour 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 rainlessness. The red mites infest comparatively lower leaves of the plant.

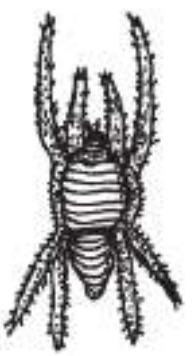


Fig: Red mite

Control measures

- Lime and sulfur should be mixed by 1:2 ratio and should be applied in the infested field with water.
- Green leaf juice of neem mixing with water by 2: 5 ratio should be applied in field.
- The insecticides should be sprayed at recommended dose.

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 dry 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. 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:

- The weeds, stubbles and roots of the previous crop should be uprooted and burnt after cutting of jute.
- Seeds should be treated before seed sowing.
- The jute seeds should be collected from the healthy plants.
- Measure should be taken to drain out excess water all time.
- Measures should be taken to control diseases just after appearing of the diseases.
- 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 10kg 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 spread 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



Fig. : Rafting of jute

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 beels, canal or rivers having low current is the most suitable for jute rafting.

To immerse of jute raft, soil clods, banana plants, mango plants etc. should not be used, because these make the fiber colour black. The jute raft is submerged 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 retting

The jute retting should be examined from 10-11 days after the immersion 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 retting is completed within 12-14 days in warm weather and within 20-25 days in cold weather.

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

1) 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) Standing in knee or waits deep water, the base of the jute plants are beaten with the hammer. Then the fiber of the base is rolled with hand and 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 decomposition of jute fiber starts. This decreases the quality of jute fiber. Therefore, jute should be properly dried and 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 fibrous 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. During the rain 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 other than jute can be cultivated. Jute suffers less 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 to 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. A discussion on cultivation of mustard seed is given 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.

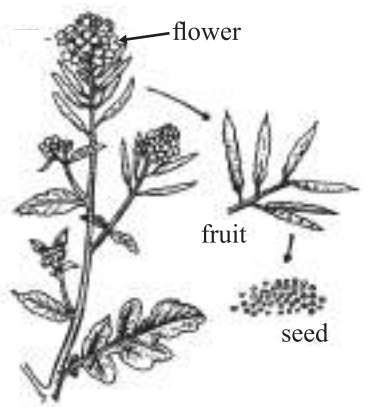


Fig: Mustard plant with flowers and mustard seeds

Sowing time: Mustard is a winter crop in Bangladesh. Based on the regional difference and 'Joe'(or suitable condition of soil and environment) 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 'Joe' condition prevail by 4-5 ploughings followed by harrowing 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.

Methods of fertilizer application

Based on the difference in variety, soil and soil moisture compost, urea, TSP, MoP, 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 28-32 gm seeds per decimal.

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 germinate within 2-3 days if sufficient soil moisture is present.

Task: The learners will visit the mustard field nearby 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 in soil. 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, water stagnancy in the mustard field must be avoided.

2) **Thinning:** Densely populated seedlings should be thinned out. The seeds should be re-sown where there is no germination of seeds at all. Thinning should be done 10-15 the days after of emergence seedling.

3) **Weed control:** No sooner the weeds are found in the mustard field then they should be uprooted. Weeds can be controlled during thinning. The land 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 coloured 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 week. 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 litre 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 assume straw color and leaves turn yellow. It is better to harvest mustard crop at morning in presence of due. 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 preserving 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 they 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 3-3.5 kg per decimal.

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 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 a crop of warm and dry climate.



Fig : Black gram

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), BINA mas-1, BINA mas-2.

b) Local varieties: Rajshahi, Sadhuhati

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 harrowing.

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 (grams/decimal)
Seed purpose	Broadcasting Line sowing	140-160 100-120
Feed or green manure purpose	Broadscasting	200-240

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, 30cm distance is maintained between rows. The seeds are sown continuously in rows maintaining 2-3 cm depth. In broadcast method, seeds are covered with soil by harrowing during final plouging.

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 (grams/decimal)
Urea	160-180
TSP	340-380
MoP	120-160
Bio-fertilizer	16-20

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 gm bio-fertilizer should be applied.

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

Intercultural operations

- The weeds found 15-20 days after seedling emergence should be removed by khurpi.
- Measures should be taken to drain out excess water if there is a possibility of water stagnancy.
- After sowing seeds, if there is lack of moisture in the land, light irrigation should be given.
- After irrigation when 'Joe' or suitable condition prevails, surface hard layer should be broken.
- 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 is blighted if the infection is severe.

Control: The disease resistant black gram varieties (Pautho, Sharat and Hemanto) should be cultivated. No sooner the infection appears, 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: Powdery layer is found on the dorsal side of the leaf. Powdery dusts are felt when touched by hand.

Control: Alternate hosts or crop residues should be burnt. Tilt or Theovit should be applied. Disease free seeds should be sown. 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

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

Control

Disease free seeds should be sown. Malathion should be applied to control white fly. The infected plant should be uprooted and burnt. Crop rotation should be adopted. The disease resistant black gram varieties 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 appea rance of the infestation of these insects, they should be collected by hand and be destroyed. If infestation becomes higher, mixing appropriate amount of Cypermethrin per litre 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 lose germination capacity and become unsuitable as food. Before storing, the seeds should be cleaned properly and dried to bring the seed moisture content below12%. For seed purpose, insects' infestation can be controlled by mixing 300 gm Malathion or Sevin 10% per ton seed.

Harvesting, threshing and storing

Crop is harvested at the last of May in kharif-I and at the last of October in kharif-II. Crop should be harvested in the morning after maturity. Based on the variety, one or 2-3 times black gram pods should be harvested. Pods should be harvested by hands at earlier harvest and the plants should be cut at base by sickle at the final harvest. Seeds should be collected by beating with the stick or by cattle after drying plants in the sunlight. After threshing, seeds are cleaned, dried well in the sun. The sun-dried seeds should be cooled and thereafter they 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 Techniques of Vegetables

We 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 considerable points in vegetable cultivation.

1**) Importance of vegetable cultivation:** Vegetables contain a lot of nutrients. The position of vegetables production and uses have reached a 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.



Fig: Different types of vegetables.

1. Vegetables as food

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 works in digestion and constipation. Garlic removes rheumatism.

1.3. Vegetables from economic point of view: Vegetables is essential for human body. Everybody should take sufficient amount of vegetables to live a healthy life. Therefore, cultivation of vegetables can fulfill the demand of our family as well as we can earn some money by selling them. By cultivating

vegetables, it is possible to use fallow lands, earn foreign currency, solve problems of unemployment, establish and develop new industries and enhance manual power of female and family members.

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

2. Classification of vegetables: A great number 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 in to three classes. These are- (1) winter vegetables (2) summer vegetables (3) whole year vegetables. e. g.

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

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

whole year 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. Nowaday, 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 whole year 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.

Good seed, land selection and preparation for seed bed, seed sowing and cultural operation in seed bed, selection and preparation of the main field, seed sowing and transplanting, irrigation and drainage, weeding and mulching, insect control, disease control, crop harvesting at proper time.

4. Methods of vegetable cultivation: The 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 spinach, green, sabuj bangle sour spinach. Besides, there are some other varieties of spinach, such as nobel jaint, banerjee jaint, 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 harrowing.

Amount of fertilizer

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

Rules for fertilizer application

a) All fertilizers except urea should be applied during final ploughing. But it is better to apply cowdung at earlier ploughing.

b) Urea fertilizer should be applied in 2-3 installments starting from 8-10 days after seedling emergence by 10-12 days' intervals.

'Ail' selection and Land preparation: Spinach can be cultivated preparing 'ail' in the land. Spinach can be sown to some extent early in the high 'ail'. Weeds should be removed from the 'ail' by spading.

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

Seed rate

Per 'Ail'	Per decimal	Per acre	Per hectare
35-40 gm	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 spraying 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 'ail' 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 the school and will submit a group-wise report on the steps involved in spinach cultivation.

Cultural operations

Weed control: Weeds should be uprooted just after appearing weeds.

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

Irrigation: This leafy vegetables requires abundant water. For that reason, based on the 'Joe' or suitable 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 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 uprooted.

Disease management: Among the principal diseases of spinach, there are–

1) foot rot disease 2) leaf spot disease 3) leaf blight disease. Somtimes downy mildew disease is noticed in spinace.

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

Yield

Per 'Ail'	Per decimal	Per acre	Per hectare
8-10 kg	28-37 kg	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. These are- BARRI-1 and BARRI-2.


Fig : Indian spinach

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

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 metre of land requires fertilizers as follows:

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

Rules for fertilizer application

a) All fertilizers except urea should be applied during final ploughing. But it is better to apply cowdung at earlier ploughing.

b) Urea fertilizer should be applied in 2-3 installments starting from 8-10 days after seedling emergence by 10-12 days' intervals.

Seed sowing and 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 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 weeding tool. Regular irrigation should be supplied during drought. Soil should be made loose by breaking crust with the help of khurpi after irrigation. Care should be taken so that water does not stay ever for a short period of time.

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 the year round. Other than Bangladesh, it is cultivated in India, China, Japan, Pakistan, Philippines, United States and South-European countries.

Varieties: The remarkable varieties are Islampuri, Shingnath, Uttara, Nayankajol, Muktakeshi, Khatkhatia,Taherpuri, Nayantara.Besides BARI brinjal 6,8,10,12 are also variety of brinjal. 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 Shravon 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.Seedlings should be uprooted at 8-10 days after emergence and planted in the second seed bed.



Fig : Brinjal plant

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 harrowing. To get good yield, the land should be deeply ploughed.

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

Rules for fertilizer application

a) All fertilizers except urea should be applied during final ploughing. But it is better to apply cowdung at earlier ploughing.

b) 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 uprooted 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 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 moisture deficit 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. Besides, Malathion or Sumithion is to be sprayed by mixing 10 ml chemical with 10 litre water. Moreover, pests of brinjal can be controlled by adopting the following technologies:

a) The wilt disease of brinjal can be controlled by using seedlings prepared from cuttings.

b) Brinjal fly can be controlled by using of pheromone and sweet gourd traps.

c) The soil-borne disease of different vegetables like brinjal, tomato, cucumber, cabbage can be controlled by using decomposed poultry littre 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 350kg. Uttara brinjal can yield up to 250 kg per decimal area.

Marketing: Brinjal can be preserved in cool and open places for several days. But brinjal should not be kept in sac for long time. Brinjal loses its normal colour and can not if it is kept in sac.

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 the year round 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 sweet gourd, ash gourd and bottle gourd.

a) Cultivation of sweet gourd

Introduction: Sweet gourd is rich in vitamin 'A'. This fruit can be eaten both green and ripen. But its main use is in ripe. 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, Barshati and Maghi have to be Sown in Magh, Baishakh and Shravon respectively.

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 gm urea, 200 gm

TSP, 150 gm MoP, 90 gm gypsum and 5 gm 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 khurpi (weeding speed) weeds if present. The base of the seedlings should be loosen frequently by khurpi. 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 (flat raised structure). 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 be applied. Among the diseases of this type of vegetables, the principal ones are powdery mildew, downy mildew and anthracnose. Diathane m 45 should be applied every two weeks.

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

b) Ash 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 Bangladesh. Young ash gourd (jali) is used as curry and mature ash gourd is used in preparing 'morobba' or 'halua' (a kind of sweetmeat made of flour, ghee, suger and fruit, etc.)



Fig: Ash gourd

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

Soil: This is cultivated in loamy soil. But by adopting appropriate management, 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 harrowing. The height of valley in the land should be 15-20 cm width 2.5 meter having suitable length. Thus valleys have to be prepared. Between two adjacent valleys, 60 cm wide irrigation and drainage canal has to be made. In household garden, ash gourd vines are lifted on the matcha, roofs of hut or on the tree.

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

Pit preparation in the valley: It is similar to 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: Water has to be supplied if the valley becomes dry. Measures have to be taken for draining out stagnant rain water. A raised bamboo frame or 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 colour on the lower leaf surface etc. diseases make the plants week. 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) Improved varieties : BARI bottle gourd 1, BARI bottle gourd 2: BARI bottle gourd 3,BARI bottle gourd 4 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 ash 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 (weeding tool). Necessary amount of water should be applied in bottle gourd plant in each day.

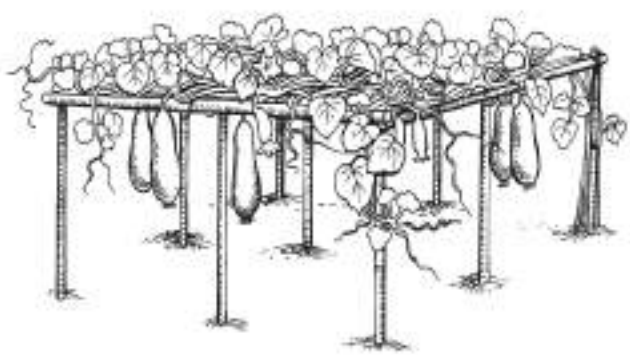


Fig : Bottle gourd on the flat raised structure

Pest management: This vegetable can be infested by red pumpkin beetle. This insect should be picked up and 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-

- abundant awns are present on the fruit.
- the nail easily enters the fruit on pressure.
- 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, 50-55 tons per hectare 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.

Varieties: BARI bean-1, BARI bean-2, BARI bean-3, BARI bean-4, BARI bean-10, IPSA bean, Ghrita kanchan, Kartika, Naldog, Baghnakha, Baromashi etc. are the popular varieties of bean.

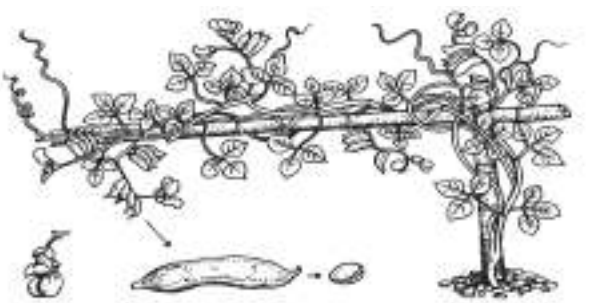


Fig : Bean plant

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 harrowing 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 farmland divider.

Pit preparation: The Pit having size of 45 cm × 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 MoP 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 as it is a crop that 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 or hoe. 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 start to grow up, 60 gm TSP and 60 gm MoP 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, they 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 differ 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 jasmine, chamely, gardenia, 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 jasmine.

Cultivation of Rose

Rose is called the queen of flowers. 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 colours. Besides, queen Elizabeth (Pink), black prince (black), Irani (pink), mirinda (red), double coloured flower eye-catcher 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 harrowing. Then, beds having size of 3 m × 1 m and 5 cm of height have to be prepared. After making beds in this way, pits having size 60 cm × 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 of 5 kg decomposed cowdung, 5 kg decomposed leaf and 500 gm ash with lower surface soil of the pit should be put on the upper surface. Thus when 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 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:** The are many weeds grow in the beds of rose. Weeds have to be uprooted.

b) **Irrigation:** Considering the soil moisture, irrigation should be provided in such way that there is no moisture deficit in soil.

c) **Drainage:** Water stagnancy in the beds of rose must not be allowed. Rose plants cannot tolerate water stagnancy.

d) **Prunning:** 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. A large number of large sized flowers bloom.

e) **Disbudding:** Sometimes after pruning, there grow a large number of leaf buds and flower buds. If all the buds are allowed to bloom, the flower size will not be 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 by 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 on 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.

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 so that water does not stagnate at the base of the plants. Besides, 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 starts to die by being black in colour from top to bottom. This symptom gradually reaches the roots through the stem and the entire plant die. To control this disease, the infested branch or stem should be cut 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 spread 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. Besides, 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, dipping 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.



Fig: Jasmine plant with 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: Layering in an earthen pot

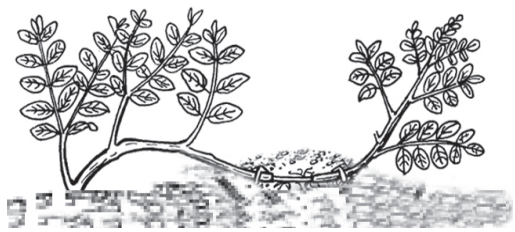


Fig: Layering in soil

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 harrowing. The organic fertilizers, urea, phosphate and MoP fertilizers have to be applied during land preparation. The seedlings should be planted at 1 metre intervals. 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 the last of summer to the 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 should be lifted from the pits and dried in the sun. The pits should be filled by that soil mixed 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 MoP 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 at all time for cultivating jasmine flower. It is necessary to irrigate at 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 is 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, it requires lower irrigation and weeds cannot grow abundantly.

c) **Prunning:** It is necessary to prune branches of jasmine plants each year. It is better 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, can be control the mites.

A yellow mottle spotted fungus is found on the leaves of jasmine flower. This disease can be controlled by applying 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, Bogura, Jashore, Barishal, 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 that of other crops. Banana is cultivated almost all over the places 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-1, 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 and 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.



Fig: Banana plant

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: 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 so that the stem of the seedling cannot enter into the soil.

Methods of fertilizer application

The name of fertilizers, dose per plant and method of application are mentioned below:

Name of fertilizers	Amount per plant	Method of application
urea	500-650 gm	One month before planting of seedlings, making a hole cowdung/compost and 50% TSP should be mixed with soil. Two months later remaining, 50% TSP and 50% MoP and 25% urea will be mixed with soil around the base of the plant. Two months later of this time remaining 50% MoP and 50% urea should be applied. The remaining 25% urea should be applied during flowering.
TSP	250-400 gm	
MoP	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 and 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. It is 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 this applying a fungicide named Tilt-250 EC at recommended dose on the infested plant and effective result may be got.



Fig : Plant infested with panama disease

2. **Cigatoga:** It is a fungal disease. It is due to 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.



Fig: Leaf infested with cigatoga disease



Fig: Plant infested with bunchy top

3. **Bunchy top disease:** 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.

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 knife.

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, pineapple is cultivated. Pineapple is cultivated extensively in Sylhet, Moulovibazar, Chattogram, Chattogram, hill tracts and Madhupur of Tangail. A large amount of pineapple is also grown in the districts of Dhaka, Narshindi, Cumilla, 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

Sandy or sandy- loam soil is suitable for pineapple cultivation. The ploughing and harrowing should be made in such a way that the soil becomes friable and level and rain water cannot stagnate. For planting seedlings, beds, each measuring 15 cm in height and 1 metre in width should be made. The distance between two beds should be 50-100 cm. For cultivating pineapple in filly slope, the selected land should be such that its slope is not much higher. The soil of the hilly slope should not be losened 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:

- 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 originated from the base of the crown seedling is called crown slip.
- The seedling that are produced from the base of the fruit is called root sucker.
- The seedling that originates from below the base of the fruit but from the above ground stem is called stem sucker.
- The seedling that originates from the under ground stem is called stamp. Stamp and stem sucker are the most suitable for pineapple cultivation.

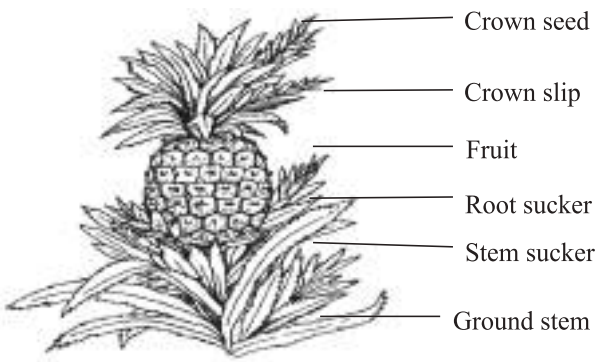


Fig : Different types of pineapple sucker

Planting of seedlings

The appropriate time for planting pineapple seedlings is mid Ashwin to mid Agrahyayan. The time of planting seedlings can be delayed for one or one and half month if there is irrigation facilities.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
MoP	25-35
gypsum	10-15

2. (a) The cowdung, TSP and gypsum should be mixed with soil during bed preparation.
   (b) Urea and MoP should be applied in 5 splits when the seedlings become 4-5 month old. Fertilizers should be mixed well with soil.

Intercultural operations

Measures are to be taken to irrigate in dry season. The canals are to be made to drain out excess water in rainy season. If the seedlings become very long, keeping 30 cm top leaves should be cut. The pineapple land should be kept weed free. Pineapple field is not affected by so harmful insects and diseases. For that reason, pest management is not discussed.

Fruit collection

From Magh to Chaitra month, when seedling become of 15/16 months old, inflorescence of pineapple starts to come out. From Jaistha to Bhadra, pineapple ripens. 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: Learners will fruit garden nearer to school. After visit fruit garden, learners will collectively write the steps of cultivation method of pineapple in a poster and present it 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 scaleless 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 excessive catching of fish. The requirement can be met up by fish culture. Method of shing and magur culture is almost the 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 scaleless, 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 greyish 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 waterbody 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 in June-July.



Fig: Shing fish



Fig: Magur fish (catfish)

Advantages of culture of shing and magur fish

There are more demand of shing and magur in the market and that's why more profit can be obtained by their culture. Method of culture is easy. They can be cultured in any types of water body even in water reservoir and cage.They can survive in adverse environment such as less oxygen, high temperature of water, even in polluted water.They can be cultured in less water and with more density. They are less affected by diseases and high tolerant. They can be marketed as live condition as they can survive in less water and even in without water. If caring done properly, fishes can be marketed early (6-8 months). Along with individual culture, they can also be cultured with carp fish, telapia 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 applying 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. 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 there is a fence. In that case, action is to be taken to kill them in the pond by koach or bait.

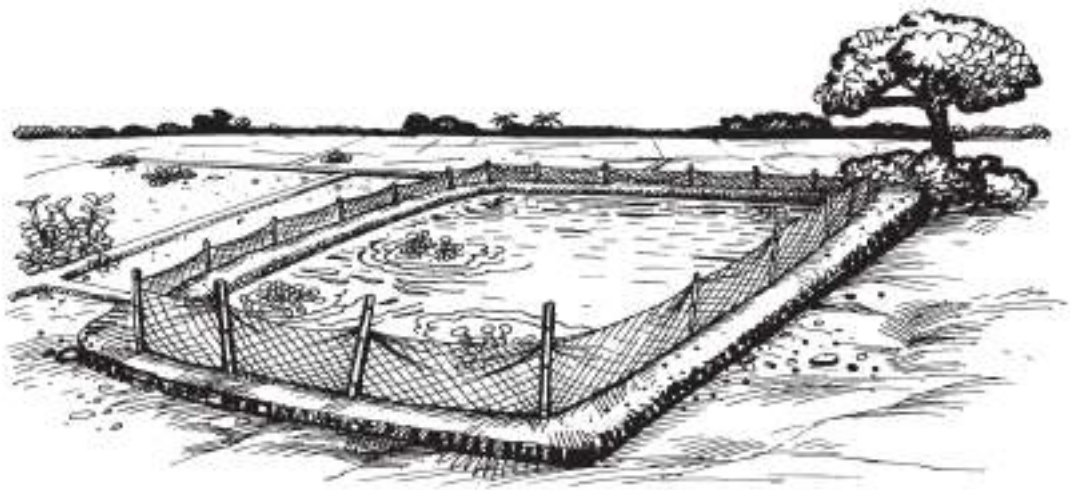


Fig: Fence of net in the pond of magur fish

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 produced phytoplankton and keep environment healthy. 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	Sample Mixing rate (%)
Fish meal	20
Meat and bone meal	
Sesame oil cake	20
Rice polish	30
Wheat bran	12
Flour/molasses	5
Vitamin mineral premix	1gm/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
>100	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 dropsy 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 1 kg lime and 1 kg salt per decimal is applied in water with 1-1.5 metre deep in pond, affected fish may be recovered within two weeks. If provided lime and salt at the same level in early winter as advanced 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 by water mixing with potassium permanganate at 5 mg/litre of water. Fertilizer application in the pond should be stopped. 1 kg lime per decimal can be applied in the pond.

Dropsy: It is a bacterial disease. It causes swelling in belly. Fish moves imbalanced way and finally die. Water is removed out by an empty syringe from the belly of affected fish. Mixing of 200 mg chloramphenicol powder with 1 kg feed should be supplied. 1 kg lime per decimal can be applied in affected pond.

Fishing

If rearing is done properly, shing and magur fish may be suitable for marketing after 7-10 months. In that time, average body weight of shing and magur is 100-125 gm and 120-140 gm, 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.

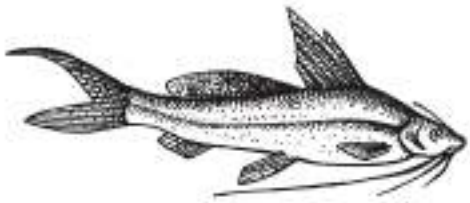


Fig: Gulsha



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 shade fall on to the pond. Predator and unnecessary fishes are to be 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, 100gm urea and TSP 50gm should be applied per decimal.

Fry stocking

After 3-4 days of applying fertilizer, fries with 3-4gm 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	

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.

Fishing

Gulsha fish becomes 40-45 gm weight at 6 months and pabda fish 30-35 gm 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 80 gm protein rich feed. But, presently, we can take only 21 gm 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 more then 12% or 195 lac 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. 2.46% 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 Culture

Concept of integrated culture

Traditionally, chicken-duck and cattle-goat are reared in about every house in the 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 chicken ducks are reared making house on the bank of 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, throwing leftover feed of poultry in the pond 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, fallen 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 remains in the land for a few months. In this case, fish faeces help to increase fertility of land. The fishes eat 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 is called integrated cultivation. In integrated cultivation, when other crops are cultivated with the fish, it is called integrated fish culturing.

Importance of integrated culture

At a time several crops are obtained from the same land with low cost. That's why excess feed is produced. One crop works as supportive to other. Environmental balance is maintained. It costs low in using fertilizer. Labour can be utilized properly (labour given for producing one crop, equal lobour can be used to produce several crops). It ensures the best utilization of wealth and prevent wastage. There is 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. Fish farming in the pond and collaborative cultivation of vegetables and fruits on the bank:

Vegetables and fruits are important source of nutrition. In addition to meeting up the demand of familial nutrition by cultivating highly nutritious vegetables on the bank of pond or gher, it is possible to generate additional income. In order to cultivate vegetables and fruits on the bank of the pond, it is better to keep it minimum 8 feet wide. The slope of the pond should be kept 1:2. The pond should be prepared maintaining the rules . It is possible to cultivate any kind of fish in the pond, for example, Carp fishes like Ruhi, Katla, Mrigal, Silver carp, Grass carp, Thai Pangas, Sarpunti and Tilapia. While farming , supplimentary food should be supplied to the fish according to the reqirement of their species.

Selecting cultivable crop:

While selecting cultivable crops on the bank of the pond, some issues should be taken into consideration. Large trees should not be planted on the bank because they can lossen the soil and can create rifts in the bank. Trees with large branches also can not be choosen because the shadow of their branches may hamper falling off sufficient sun light on the ponds of the fish. Such crops should be selected which at the time of culivation make the soil of the bank less loose. Considering these matters, cucumber , pumpkin, snake gourd etc. may be cultivatd as the summar vegetables and gourd bean, cowpea may be cultivated as the winter vegetales. Again , as the short time cultivable fruit on the bank of the pond, banana pineapple, papaya and as the long term fruits like lemon, guava and coconut may be cultivated.

Preparation of land on the bank of ponds: 2 weeks before planting or sowing fruit or vegetable crops, pits of different sizes should be made depending on the crop. Pit size can be 60-100 cm in diameter and 45-90 cm in depth. In case of vegetables, one pit should be at a distance of 2 meters from another pit. A few seeds can be sown in a pit and 2-3 seedlings should be allowed to grow in each pit. In case of creeping plants such as gourds or beans, it is necessary to provide poles or lofts with bamboo on the banks of the pond. The plant grows on the lofts and bears fruit. Trees with soft trunks such as papaya may need to be staked. The pits made for planting on the banks of ponds usually do not require the use of fertilizers. Only adding mud from the bottom of the pond works because the mud that forms at the bottom of the farming pond is very fertile. This mud can be used instead of manure. It is better to apply fertilizer in a ring system around

the seedling after planting. If it is necessary to water the plants, the pond water can be used at the base of the plants. When the trees no longer bear fruit or vegetables, the leaves of the plants or the dead and fallen leaves during cultivation can be used as green manure or compost. In that case there is no need to use fertilizers in the fish pond.

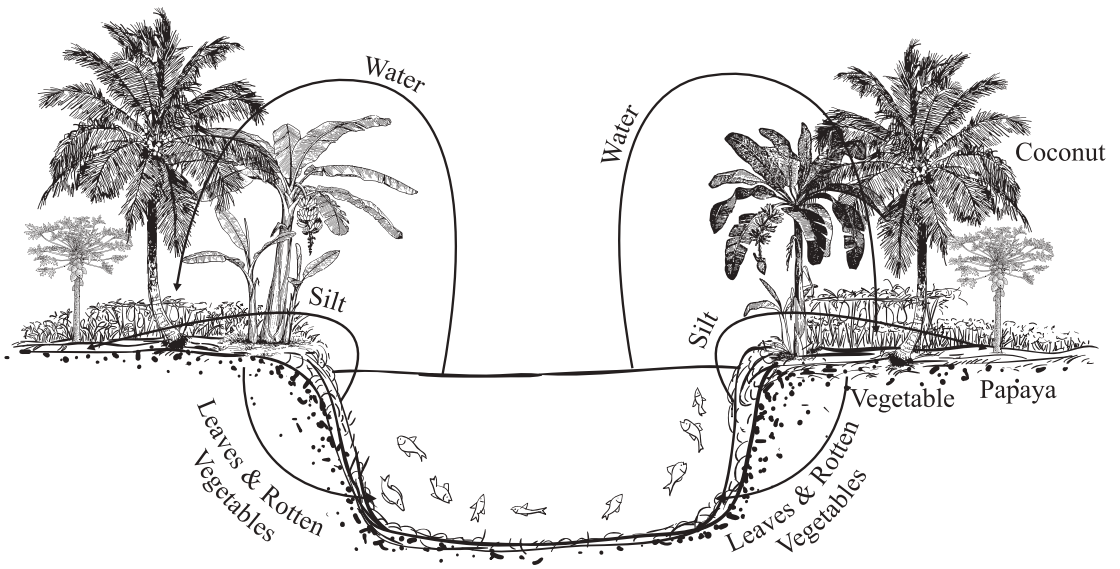


Fig: Fish cultivation in the pond and collaborative cultivation of vegetables and fruits on the bank

Advantages of growing crops on the bank of ponds:

1. Pond banks are usually formed by the bottom soil of pond so it is very fertile for any kind of crops.
2. Excess mud from the pond floor can be applied as fertilizer to the roots of the plants. So there is no need to apply other organic fertilizers.
3. Plants can be irrigated with pond water.
4. The cultivation of fruit and vegetable helps to maintain a good ecological condition in the pond area.
5. Roots of produced crops help to hold bank soil and prevent erosion.
6. Horticulture crops, especially fruit crops provide good profit to the pond owner along with fish and help to meet the daily household needs.

Production: It is possible to easily produce 20 to 30 kgs of fish per year by cultivating fish in ponds and fruits and vegetables on the banks according to the rules, which can meet the family needs and generate additional income.

B) Fish and shrimp culture in rice field

For rice cultivation, there should be water in land for a long time. If this rice fields are made well prepared, several cultivation of rice, fish & shrimp is possible within a year. According to specialist's opinion, presently 2.0 lac hectare lands in Bangladesh are especially suitable for culturing fish and shrimps in rice field which can be used now. Another 3 lac 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 eats 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: If the land can keep water for at least 4-6 months and at least 12-15 cm height in ail 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

Making/repairing of ail of land: Ail of land should be built strong. It should be better to make ail with 30-60 cm higher than water level at natural flooding. Ail should be wide enough. Thus, ail will not be broken early and some vegetables can be cultivated in ail.

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 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 metre. 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 of ditch and canal. (2) If it is necessary to remove weed or 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 in 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 the 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 transplantation: Rice seedling should be planted row wise. In that case, space between row to row and seedling to seedling should be 20-25cm and 15-20 cm respectively. Space of 35-40 cm should be maintained after planting 5-6 rows serially. It helps to move fish and shrimp easily and natural fish feed can be produced rapidly as it allows enough sunlight on water.

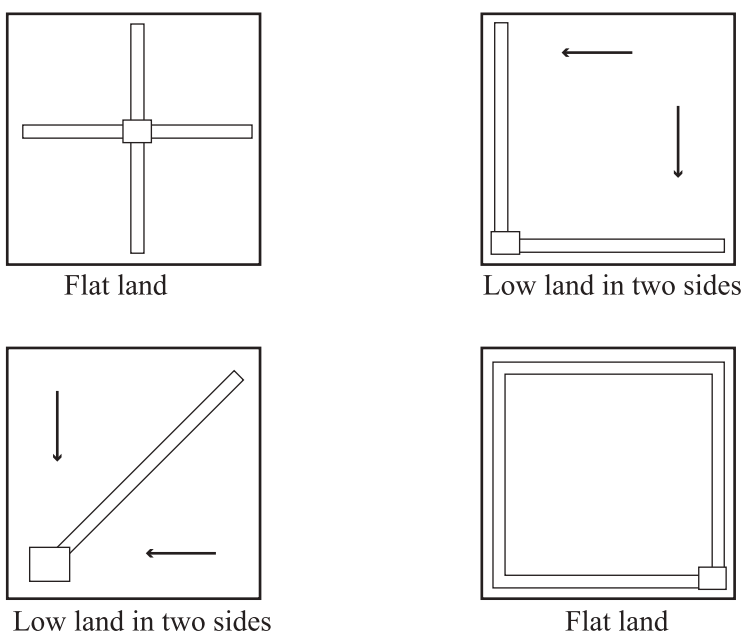


Fig: Several design for making ditch and drain in rice field

Selection of fish species: Quick growing fish like carpio, shwarputi, telapia 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 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 given to fish and shrimp after making small sized balls. This will be supplied at 3-5% of their body weight by making three parts of the 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 there is little water in field. In case of any disease in fish, they have to be taken to the ditch and 1 kg lime per decimal is to be applied.

Collection of rice, fish and shrimp: At rice harvesting, they are to be harvested by reducing water in the 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 the next crop.

Section-6
Method of Rearing Domestic Animal and Poultry

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, take feed and take rest. There are many advantages in livestock house. If livestock is reared individually or as group in the house, management will be very easy and production cost will be less. It is good for livestock if they are allowed to roam around in the environment around rather than keeping them confined at all times.

Objective of housing

1. To manage comfortable environment.
2. To give shelter and rest for livestock.
3. To protect from bad weather.
4. To protect from insects and wild animals
5. To protect from thieves.
6. To make animal docile.
7. For proper pregnancy, parturition and calf management.
8. To produce more milk and meat from livestock.
9. Milking efficiently.
10. For easy and proper supply of feed and water.
11. Taking intensive care for every single animal.
12. To provide timely treatment.
13. For easy cleaning of livestock housing.
14. To prevent and control diseases.
15. To conserve the cow dung and other waste materials.
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 dry and flood free area.
2. A little 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 drainage system from farm.
7. Livestock housing area to be 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 in single row if cattle number is less than 10 and in double row if cattle number is more than 10.

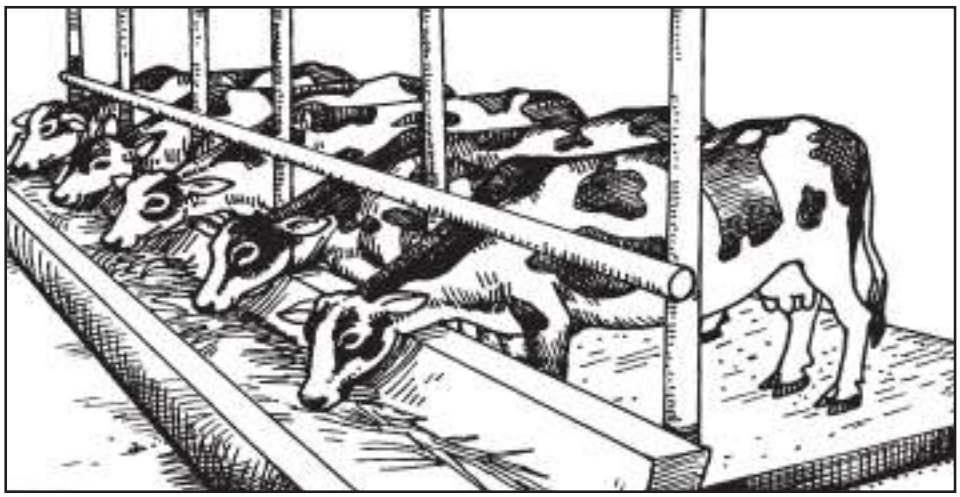


Fig: Cattle housing

Cow Rearing

Livestock and cow rearing are closely related to 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.

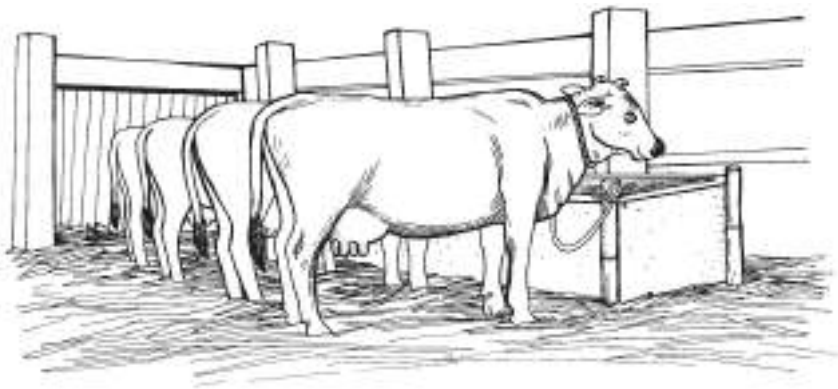


Fig: Dairy cow in the farm

Caring for cow

The objective of caring for cows is to keep them 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 with sufficient amount of concentrates. Before and during 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 it is 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. After parturetion, placenta should be bruied immediately after falling. A 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. If the cows do not feel procreative sexual urge after 90 days of parturition, cows should be checked up by a doctor to bring into that stage. Another objective of cow rearing is to keep the 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 into 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. Everyday a cow must be given adequate amount of roughage and green grass.
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 litre milk production.
3. 40-50gm bone meal and 100-120 gm common salt is 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-

- To facilitate lighting and ventilation during house making and protect disaster.
- To keep feeder and drinker neat and clean.
- To avoid rotten, stale and dirty feed and water.
- To provide fresh feed and water always.
- To follow the microorganisms free method during breeding and parturition.
- To drain out faeces and urine quickly.
- To separate sick cow and dispose dead cow.
- To follow deworming practice regulary
- 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, a 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 calf rearing is important in Animal Husbandry. Cattle in its very early stage is very vulnerable to disease. Calves are more than 24 percent are of the total livestock rearing in our country. That's why, to get a healthy calf, in its proper and sufficient balanced ration is needed 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 metres). 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 metres). Straw can be used as bedding materials in a calf barn. In concrete floor, care should be taken for keeping floor free from mud or dampness.

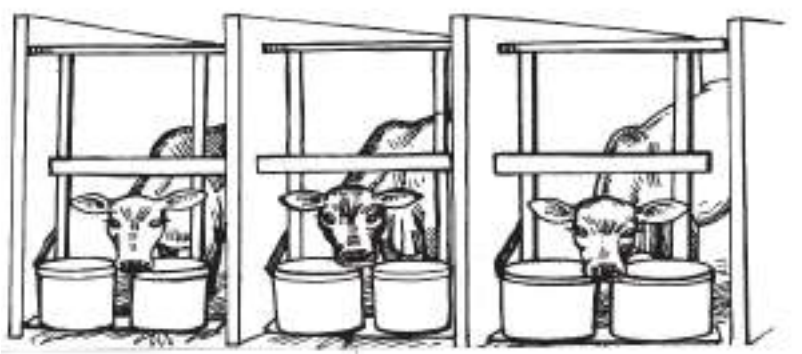


Fig: Calf in small barn of house

Caring for calf

Caring for calf means proving 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 a calf to rear or provide special care during the time from birth to coming of age.

Acitivities after birth of calf : Just after the birth, the calf should be kept on gunny bag and face should be cleaned. Then the calf should be placed before the cow for cleaning its body. If the navel flap is not removed out, it should be cut by blade at 5 cm away from vavel and tincture iodine, benzene, dettol or savlon sohuld be used.

Teaching calf for suckling milk from cow

Just after birth colostrum should be provided to calf. 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 cows when its mother goes 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.

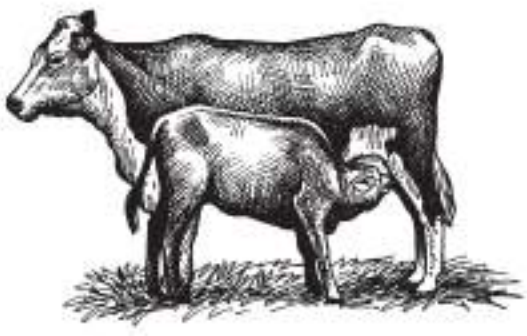


Fig: Calf is suckling milk from its mother provided to



Fig: Milk is being fed to 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 alternative 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 alternative to giving required amount of feed supply for proper bodily growth of calf. Generally, feed is supplied basing on body weight. Feed should be supplied regularly according to feeding chart and requirement of growing calf from birth until its becomes self reliast. Faeces should be drained out properly from the calf house to rear them in healthy conditions. Calf house has to be kept clean by regular changing of bedding materials. The house, where calf lies, has to be kept dry enough.

Timely taking calf into and outside of the house timely

Calf should be taken into and outside of the house timely. Calf should not be kept in confinement 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.

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 well productive cow. 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, with the start of rearing sheep, farm size will be increased within few years and the business will be profitable. They can only live on grass. But if provided concentrate feed, well production can be achieved.

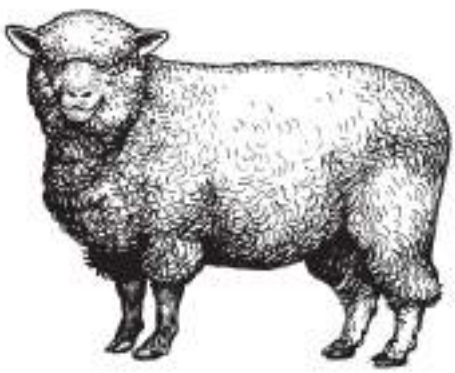


Fig: Merino sheep with fine wool



Fig: Karakul sheep with coarse wool

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. Mentionably, 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.

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:

- To take rest at night.
- To protect from wild animal.
- To protect from heavy wind and rainfall.
- To perform milking from high producing sheep.
- To take care for pregnant animal, parturition and for lamb.
- To clip sheep wool.
- 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 takes shelter here at night after grazing over day. Straw is used in the floor.

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.

Necessary space for aged sheep

Floor on slat (Square metre)	Floor on ground level with straw (square metre)
0.45-0.55	0.65-0.95

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 200-250gm should be added daily at feeding chart for ewe before one month of parturition.

An aged sheep needs 2.00-2.5 kgs green grass and 250-300 gms concentrated feeds daily.

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 estimating 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 to be 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, Jashore 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 villages of Bangladesh, ducks have been reared by this method. In this method, ducks are released in the morning and kept in confinement condition at night. Normally, no feed is given to duck because, they take feed by searching all day long from natural

sources like small fishes, snails, aquatic plants, various grains and insects. Duck lays at morning and that's why they are kept in confinement 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

- Requires less labour.
- Low feed cost.
- Low cost for making house.
- Well adaptation with the environment.
- Well body growth and production.



Fig: Duck rearing in extensive method

Disadvantages of duck rearing in extensive method

- Requires more fallow lands and water bodies.
- Ducks may be affected by wild animals.
- They may be affected by harsh weather.
- Regular observation can not be maintained.
- Sometimes, they destroy land crops.

Intensive method

In this method, ducks are kept in confinement 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 littre 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

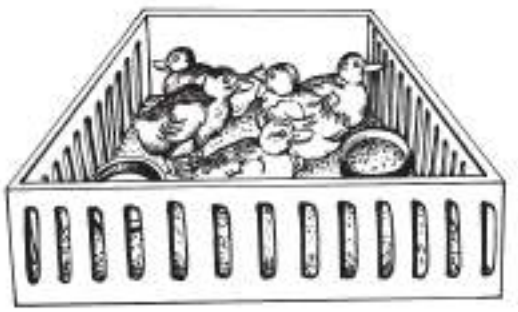


Fig: Ducklings in cage

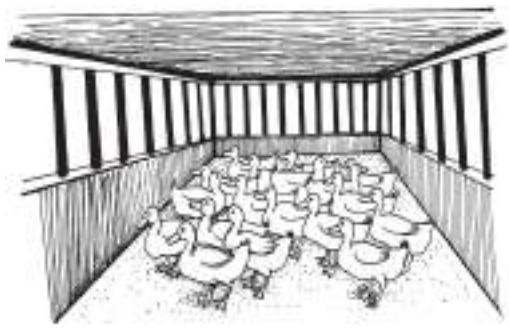


Fig: Adult duck rearing in intensive method

Advantages of intensive method

- Uniform feed intake.
- Easy way of disease prevention.
- Requires less labour.
- Wild animals cannot affect the ducks.
- Requires less space for each duck.

Disadvantages of intensive method

- Requires more feed supply.
- Requires high cost for making house.
- Lack of free light and air for ducks.
- Need intensive care.
- 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 0.93square meter (nearly 10 square feet) floor space in a fixed place. If the place is not be a natural 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

- Ducks can get facility for swimming.
- Growth of body remains normal.
- Less labour is required.
- Equal feeding is confirmed.



Fig: Ducks rearing in semi-intensive system

Disadvantages of duck rearing in

semi intensive method

- Requires high cost for duck rearing.
- Intensive care is needed.
- Feed cost is more.
- Equal feeding is not confirmed

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.

Task: The learners will write down the advantages and disadvantages of raising duck by floating method and will present in the class.

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

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 household beauty. Besides tea, coffee, sugar, cotton etc. special agro-materials, bamboo, wood, coconut husk, mango etc. are also play their roles in different industries as industrial raw materials. The small cottage industries in Bangladesh have started through the bamboo-stick. Therefore, we all should know what types of materials are produced from bamboo-cane, 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 taste. 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.

Various types of tasty foods like mango morobba, mango chatni, mango catchap, amchur, amsatta, mango juice etc. are being produced, from green and ripe mangoes through processes.

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 household materials are made from coconut husk.

Such as– Cooshon of big cot, Wallmet, Papoose, Rope etc.



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 household 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 household 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, household 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 at home and abroad has been found. Nowadays, laminated bamboo floor and wall cover, mat, cushon, 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 byproduct of paper, rayon is also prepared. Paper industries have been developed in various places of Bangladesh. Most of the bamboos of Chattogram 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, households and building constructions are the main. The bamboo is used in the various works involved in household 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 to 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
(basket for carrying goods on the need)



Fig: Winnowing fan



Fig: Polo
(a basket of wieker-work for catching fish)



Fig: Bamboo made chair and sofa

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.

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.

Cane and its uses

Cane is a natural forest resource in Bangladesh like wood and bamboo. There are various types of cane found in the forests of Bangladesh. The agricultural lands are not used to produce cane. A large amount of cane is produced naturally in Sylhet and Chattogram hill tracts regions. Cane belongs to the family of plum and coconut but its plant is spiny vine and shrub in nature. It bears fruits, which is called cane fruit.



Fig : cane plant

Cane made materials

Cane is well known to all due to its industrial quality. The stem of cane plant is used in cane industries. The stem of cane is hard but is flexible and suitable for sawing.

Making furniture from cane

Furniture made from cane is originally natural. There is no artificiality in it. Furniture can be made by using cane as like as thread and embracing any hard materials (rod, bamboo) with it. Again by drying thick stem of cane and making hard structure with it sofa, chair, table, book self, cot, cradle, wicker stool, shoe stand, corner self, wear drops, rocking chair, easy chair etc. furniture can be made.

Before making furniture, it is necessary to cut the canes into appropriate sizes and thereafter be treated. Making solution by boric acid and water at approximate rate in a chari and deeping canes in this solution for one week, they can be treated well. Thus, ghoon or other insects and mites will not infest.

Cane made industries

The uses of cane are extensive. Cane made materials are the identity of rural industry. The cane made materials can be divided into the followings:

1. Light construction industries
2. Bunon industries
3. Small handicrafts
4. Mixed industries

Light construction industries

Cane- made light construction industries mean the furniture made by thick stem of cane which can bear light weight. The main examples of light construction industries are- sofa set, chair, cot, partition, shelf, table etc. The cane which are used in these industries are comparatively thick and larger in amount. To use this cane, 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 cane, udam cane, kadam cane etc. are used in these materials.



Fig : Sofa set made by cane

Sawing industries

In sawing industries, narrow and flexible bets are used. The narrower sheets are also got by sawing this cane. This cane product is used in bindings and sawing works. By sawing works, the light construction industries are made fancy and attractive. For sawing industries, bandoriak and jail cane are used.

Small handicrafts

Actually, all the cane industries are handicrafts- either it is small or large. The beautification materials that are produced using unnecessary residues of construction industries and sawing industries are called cane made small handicrafts. The example of cane made small handicrafts are toys, flower basket, pen stand, cane made basket of rattan, shoe rack, wicker stool, vase etc.



Fig: Cane made dhama

Mixed industries

The materials which are made by mixing bamboo, wood, plastic, nylon, steel etc. with cane are called cane made mixed industries. Mixed industries are produced by using wood, bamboo etc. instead of thick cane to make cradle, wicker stool, rack, shelf, chair where there is lack of thick cane. Again, where there is lack of thin cane, nylon or plastic cane is used with thick cane to make cot, box, sofa etc. instead of thin cane.



Fig : Flower Vase



Fig: Flower basket

Section-8
Medicinal Plants and their Uses

Medicinal plants

There are various types of plants in our surrounding environment. 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, they 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 controlling 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. Nowadays, due to the increase of population, multiple uses of lands has been increased. Besides, due to ignorance, negligence and lack of care, 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 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

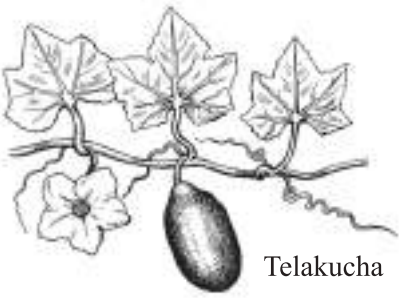

Arjun


Haritoki


Amla


Bahera


Aloe vera


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

   Herbal uses: Thankuni is used for the act of curing intestinal diseases of children specially to control indigestion and discentry. Besides, Thankuni is life span increaser, memory increaser, and healer 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

   Herbal 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

   Herbal uses: The juice of this plant is very effective medicine for curing fever of children, indigestion and liver trouble.

4. **Basok:** It is a shrub. Leaves are simple, opposite, long.

   Usable part: Leaf extract

   Herbal uses: It is mostly used in curing diphtheria. Taking juice of basok leaf mixing with zinger juice and honey in equal proportion is very effective.

5. **Sarpagandha:** Sarpagandha 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 root and leaf.

   Herbal uses: The juice of sarpagandha root and leaf is used in high blood pressure. It is also used in the treatment of madness.

6. **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 curing 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 cured. By taking bark mesh with milk blood dysentery get well. By applying fine crush of arjun bark on the face mixing with honey mechta spot is disappeared.

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. **Amla:** 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.

Usable part: Fruit

Herbal uses: Juice of anole leaves is preventive to dysentry 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 amla fruit with trifala anemia, jaundice, skin diseases, diabetis, hair falling etc. diseases are cured.

9. **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 cured. 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, diarrhoea 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 falling.

10. **Aloe vera :** It is a herbaceous plant. It has fleshy long leaves with spiny margine.

    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 for the treatment 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 for curing 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 cure diseases by medicinal plants. Because the treatment systems by medicinal plants are easily available, low cost and it has no side effect. For that reason, the ayurvedic and urinary treatments having quality of medicinal plants, has acquired much popularity in our country.

Although the improvement of modern treatment systems has reached its higher level, people are feeling the necessity of the treatment systems with ancient medicinal plants. 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 learners will submit a report preparing on 'Medicinal plants in controlling diseases.'

Exercise

Multiple Choice Questions

1. Which insect attacks the rice grain at the beginning of its development?

a. Stem borer b. Rice hispa c. Rice bug d. Rice case worm

2. The characteristics of Gazi rice are –

i. The plant is short ii.The leaves are drooping iii.The yield is high

Which of the following is correct?

a. i and ii b. i and iii

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

3. What are the symptoms of jute stem rot disease?

a. Black ring-like spots on the stem b. Dark brown spots on the stem

c. Infested areas become cracked d. Black spots on the stem

Read the following stimulus and answer questions 4 and 5 :

Safi Mia is a jute farmer. This year, he cultivates CC-45 and Chin Sura Green jute varieties on his two plots of land. He harvests CC-45 variety jute in the month of Ashadh and Chin Sura Green variety jute in Bhadra. He obtains 1500 sheaves from each plot of land. He uses urea fertilizer while harvesting jute.

4. The reason why Safi Mia harvests jute from two plots of land at different times is –

i. Due to the difference in maturity

ii. Due to the difference in fertility of the land

iii.Due to the difference in the variety of the crops

Which of the following is correct?

a.i and ii b. i and iii

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

5. How many kg of urea does Safi Mia need to decompose jute?

a. 15 kg b. 20 kg

c. 25 kg d. 30 kg

Short-answer questions:

1. Urea fertilizer is not required in bean cultivation -- Explain.
2. What is pruning? Why is rose pruning done?
3. What are the types of pruning tools used for banana cultivation? Explain the best one among those tools.
4. Grass carp should not be used in fish farming in paddy fields. Explain.
5. What is meant by Three Myrobalan (triphala)? Explain.

Creative Questions:

1. Ayesha Begum lives in a high-rise house in a marshy area. After receiving training in vegetable cultivation from the Department of Youth Development, she successfully grew spinach on 05 acres of land in her yard. Following this success, she planned to cultivate spinach in the elevated areas of her land situated in the marshy region.
   a. Write the name of a variety of spinach.
   b. Explain the reason for the additional application of 'urea fertilizer' in spinach cultivation.
   c. Determine the amount of organic fertilizer Ayesha Begum applied to the land.
   d. Analyze how Ayesha Begum's plan will affect her agricultural activities.

2. Observe the two pictures below and answer the questions --

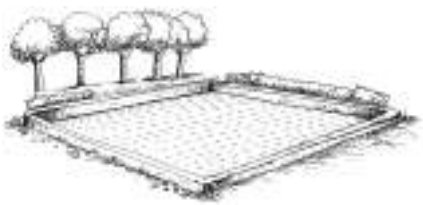


Figure-a



Figure-b

   a. What is integrated farming?
   b. How is land use doubled in integrated farming? Explain.
   c. Which of the methods shown in Figure A and B has lower production costs? Explain the reason.
   d. Which method shown in the figure is better in increasing family income and nutrition? Explain the rationale.

3. Farmer Torab, a resident of the banks of the Meghna, cultivated jute on his two acres of land. After a few days, a type of insect resembling a caterpillar attacked his jute field. Torab remained unfazed and effectively managed the insect issue. Consequently, the following year, due to the unexpected jute harvest on his land, other farmers in the area decided to cultivate jute as well.
   a. What is the name of the organization that develops jute varieties?
   b. Explain the reason for sowing more jute seeds than the usual amount.
   c. Explain the method of controlling insects on farmer Torab Ali's land.
   d. Evaluate how much the farmers' decision will benefit the area's socio-economic development.

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 dam sides, hilly areas and coastal areas is called social afforestation.



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 of 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 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 felling;
- describe the preservation methods of wood sheet or woodlog;
- describe the methods of measuring sheet or woodlog;
- explain the necessity of tree felling 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 31.04 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	2.10	13.77
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, Bandarbans, Sylhet, Habigonj and Moulavibazar.

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 live elephant, monkey, pig, beer, wild hen, fox, tiger etc, wild animals 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 Cumilla is called plan 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 households, making furniture and in other construction works. The wild animals of this forest become almost extinct. At present small number of tigers, deer, monkeys, snakes, dove, magpierobin and martin are found in some places. The total land area of this forest is 3.86 lac hectares.

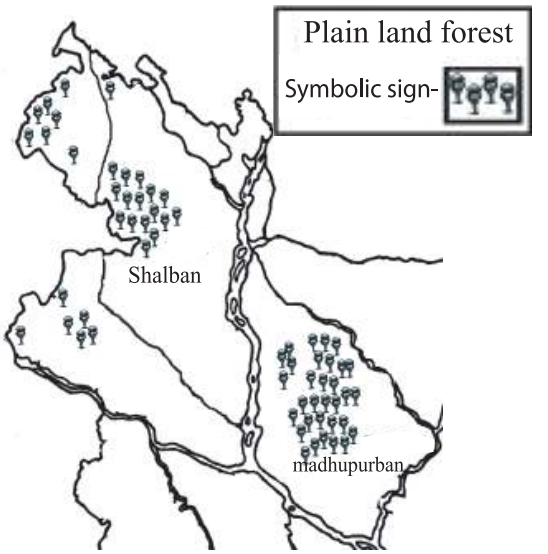


Fig: Plain land forest

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 form the water stagnant soil through normal roots. Important trees of this forest are geoa, garan, pashur, keora, byne, kakra, golpata and thick cane. The great Royal Bengal Tigers live in this forest. There live panther, deer, monkey, python, various types of birds and insects in this forest. Crocodiles and other aquatic animals live in rivers and canals of sundarbans. Every year, a huge amount of honey and wax is found from sundarbans. The sundarbans is the historical forest of Bangladesh. The most largest and resourceful mangrove

forest of the world is the sundarbans. 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.

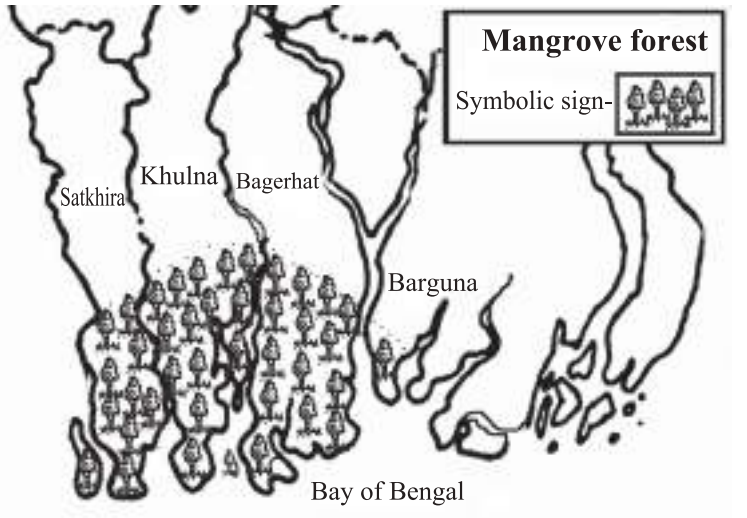


Fig : Mangrove forest

Rural forest: There are about 7.74 lac hectares of land 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 the amount of this growing stock. The amount of wood obtained from the report on 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 metre
Hilly forest	20.71
Mangrove forest	12.32
Plain land forest	1.20
Rural forest	54.68
Total	88.91

* Million = 10 lac

Types and characteristics of forest.

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 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 been established mainly in the high and medium high land.

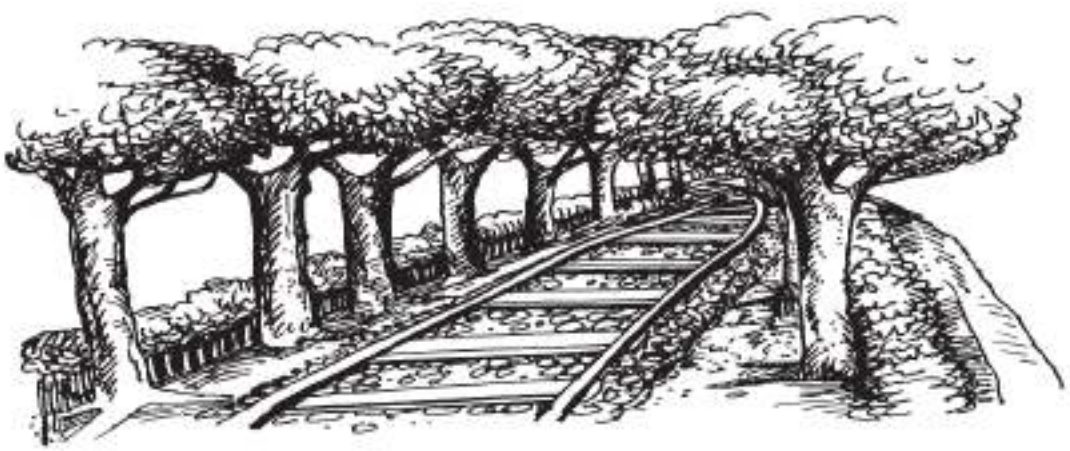


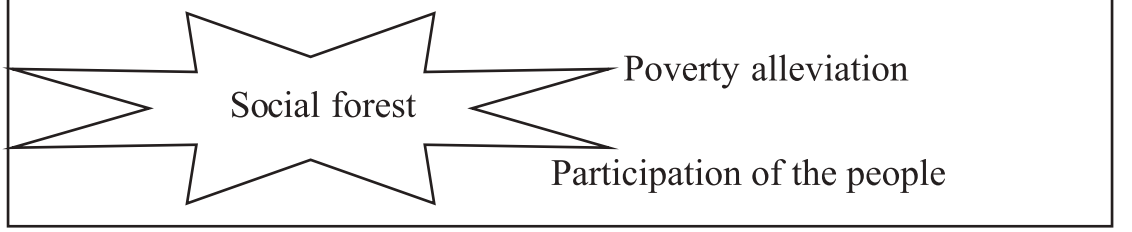
Fig: Social afforestation

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.



Agro-forests :

The agro-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 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 balanced and to protect from natural hazards.

Task : The learners will cite two characters of forest individually.

Section-2
Forest and Wildlite Conservation Act

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 forest. 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 in line with the demand of time. 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. accroding 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 of 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 violation of 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 violation of the above conservation act 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 offence. 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 offence.

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 are 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. A section of dishonest people is destroying forests. The residents nearer to the forests are grasping forests. The illegal residences 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.

Secton-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 grafting by following 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-

- timely availability of improved healthy and larger seedlings.
- facilitates marketing and distribution of seedlings having different ages.
- facilitates cultural operations of many seedlings at a time.
- seedlings can be produced at low labour and low cost.
- many seedlings can be produced at lower cost.

Contribution of nursery in perspective of socio- economic condition

- Producing seedlings of forest, fruits and medicinal plants in the nursery are produced and sold to public. Consequently, it increases tree plantation.
- Many people live by nursery.
- Many people get economic benefit by nursery business.
- The public and private forestry are established with the seedlings produced in the nursery.
- 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 on media used

Nurseries, based on the media used 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 on 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

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.

Task: The learners will prepare a list of tree by visiting forest nursery in groups.

Forest Nursery Seed Management

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 seeds will have to be stored properly for the duration started from seed collection till sowing. The seeds can be infected by insects and mites, fungus and bacteria etc. if they are not stored properly. Consequently seed quality is detoriates. 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 in 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.

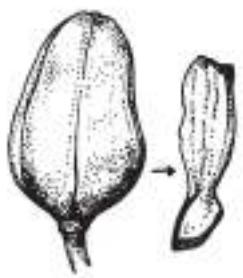


Fig: Mehgoni capsule



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, karoi 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, 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 preservating, 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 preservation 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 shinny, 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 passerby. 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 can 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 right 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 essentials to have a main road to enter into the nursery. The main road should be connected with the streets inside the nursery in planned 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 1 m × 3 m × 20 cm 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 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, Karai, 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, Shal, Jarul, Shilkarai, Mehgoni, Telsur, Chapalis, Jackfruit, Blackberry etc.

Methods for tree felling

- 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.

- Before felling, the branches of the tree should be cleaned. Thus the felling of tree can be controlled.
- 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.
- 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.
- 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.

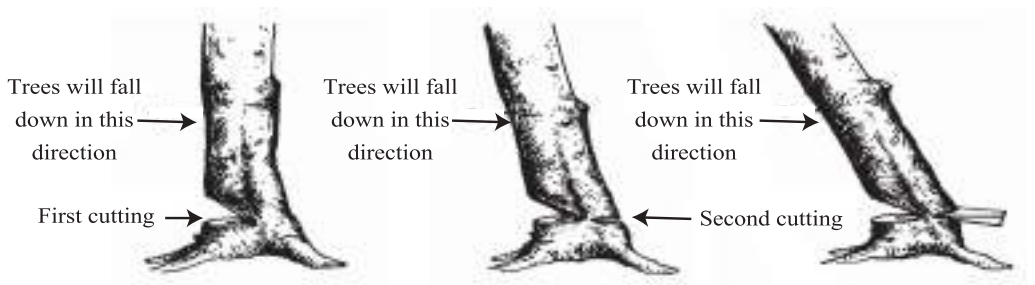


Fig: Method of felling trees

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:

$$\text{Volume} = 0.08 \times \frac{(C1)^2 + 4\times(C2)^2 + (C3)^2}{6} \times \text{Length}$$

Where C1 = Circumference of the narrow end

C2 = Circumference of the middle place

C3 = Circumference of the broad end

If length and circumference are measured by metre then volume will be cubic metre.

Example : The Length of a Garjan Log is 6 metre. It's circumference of the narrow end is 1.5 metre at the middle 2.0 metre and at the broad end 2.5 metre. What is the actual volume of the log.

Solution:

$$\text{Volume} = 0.08 \times \frac{(C1)^2 + 4\times(C2)^2 + (C3)^2}{6} \times \text{Length}$$

$$= \left\{0.08 \times \frac{(1.5)^2 + 4\times(2)^2 + (2.5)^2}{6} \times 6\right\} \text{ cubic metre}$$

$$= \left\{0.08 \times \frac{2.25+4\times4+6.25}{6} \times 6\right\} \text{ cubic metre}$$

$$= \left\{0.08 \times \frac{24.5}{6} \times 6\right\} \text{ cubic metre}$$

$$= \left\{0.08\times24.5\right\}$$

Volume = 1.96 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 in 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%.

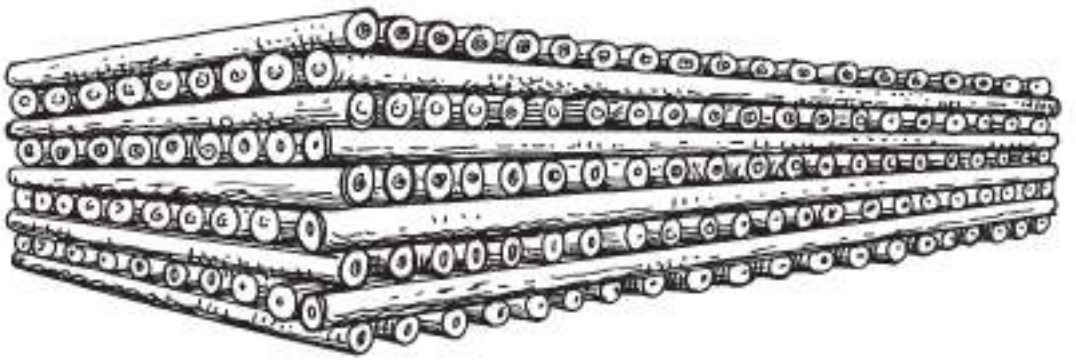


Fig : Air drying

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 thicken 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 is, 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 resources in a forest area, 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 is at threat 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, Barishal 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 jhao 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.

- 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.
- The location in which trees are planted in coastal barrage is highly sloped. For this reason, trees are planted in rows. Trees should be planted in alternate arrangement in rows. Actually though the trees are planted maintaining wider distance, the distance between trees is maintained 2m×1m. Consequently, the efficiency of soil erosion is increased.

- The coastal plants have desert characteristics, such as thick cuticles on leaf. For this reason, these plants are of drought tolerant.
- 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.
- 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.
- The plants which can tolerate submergence and salinity should be planted for coastal afforestation.
- The plants having hard and tall stem; small leaves and ability to 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 metre. 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: It grows mainly in 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 the 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 meter 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 dept 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 be analyzed from the various points of view as follows:

a) Environmental necessity

- Trees of this forest area control soil erosion of coastal regions, increase soil fertility and increase ground water table.
- Help to make the environment suitable for living by decreasing salinity of soil.
- Keep the balance of oxygen and carbon dioxide in the environment, protect creation of heat and make the air refresh.
- The coastal green prevaricate escape the men and other organisms from coastal storm, tidal surge and cyclone.
- It controls land slide, sand storm and cyclone and helps in rainfall.
- 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.
- 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) Aesthetic necessity

The green prevaricate made by coastal afforestation creates an unprecedent beauty. 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

- 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.
- The crops produced from fruit trees like coconut, date, plum, banana, mango etc. meet up the food demand and brings economic development.
- 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.
- Fuel wood, pillars, furniture, households, 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

Multiple Choice Questions:

1. The amount of hill forest land –

a. 12.16 lakh hectares b. 13.16 lakh hectares
c. 14.16 lakh hectares d. 15.16 lakh hectares

2. Which of the following tree groups belongs to the hill forest?

a. Garjan, Goran, Gamar b. Gazari, Gewa, Segun
c. Telsur, Champa, Chapalish d. Jarul, Raintree, Pashur

3. Most of the forests of Bangladesh are located in –

i. South-Eastern region
ii. South-Western region
iii. North-Western region

Which 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 stimulus and answer questions 5 and 6:

Diya was watching a television documentary about forests. At one point, she noticed that most of the fruits on the trees in that forest were germinating while still attached to the branches. Once the seedlings matured, they fell to the ground and became embedded in the mud.

4. In which of the following plants did Diya see germination?

a. Goran b. Gamar

c. Gorjan d. Gajari

5. The characteristics of the forests seen by Diya are –

i. The soil is muddy

ii. Aerial roots are present

iii. The branch roots are long

Which of the following is correct?

a. i and ii b. i and iii

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

Short-answer questions:

1. Explain why an axe and a saw are used when cutting trees.
2. What is wood seasoning? Why is it necessary?
3. Explain two main characteristics of plants suitable for coastal forestry.
4. What is a respiratory roots? Why do plants in mangrove forests have respiratory roots?
5. What are the forest rules? What are the penalties for violating these rules?

Creative Questions:

1. Mr. Zaman planted mangium seeds in a 4-square meter plot of land on the south side of his house, next to a pond, as recommended by the agriculture officer. For this purpose, he used 15 cm × 10 cm poly bags. By doing so, Mr. Zaman achieved great success.
   a. What is a nursery?
   b. Explain the need to establish a nursery.
   c. Determine the number of seedlings in Mr. Zaman's nursery.
   d. Analyze the reasons for Mr. Zaman's success.

2. Sufia Begum cut down two mahogany trees that had been planted 20 years ago for use in the house during construction. The workers used axes to fell the trees. The logs from the two trees measured 8 meters in length. The diameter of the thin end was 2 meters, the middle section was 2.5 meters, and the thick end was 3 meters.
   a. What is wood seasoning?
   b. Explain what type of plant Gamma, Shishu, is based on the rotation period.
   c. Determine the volume of one of Sufia Begum's trees.
   d. Analyze whether the action taken by Sufia Begum 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 activities, 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.



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

- can explain the concept of agricultural co-operatives;
- can analyze the importance of agricultural co-operatives;
- can explain the collection and uses of agricultural inputs through agricultural co-operatives;
- 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, preservation 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 it is cricket, bat, ball, stamp; if it is badminton, net, pillars of net, cork, bat; if it is table tennis, table, bat, ball etc. All companions collect money to buy these instruments. Again, some extra money are kept to buy instruments whenever the goods for playing become shortage. 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 activities 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-operative is generally of area based or regional based. It is due to addition of science and technology in modern agriculture, agriculture has become very expensive. Besides, the farmers cannot hold the crops they produce. The price of crops fall down if there is bumper production. Sometimes, the price falls so low 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; and 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 prepare 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 inputs 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 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. 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 the 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 purchase, 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 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, cattle rearing 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 provide 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 co-operative.

Section-3
Preservation and Marketing of Agricultural Product on the Basis of Agricultural Co-operative

Preservation 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 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. Farm can be kept safe effectively even if diseases break 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 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 sothat 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 co-operative 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

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. The second very important step is adding land and money to co-operative. Before that, it is required to finalize the main conditions i.e, regulations of co-operative through discussion. In this regard, assistance can be sought from the office associated with the national co-operative department. Suggestions 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 the 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 built 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 co-operative 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 co-operative organization is the heart of agricultural co-operative. The more the co-operative is skilled, honest and strong, the more it will get profit.

Task: Learners will make a report about the usefulness of agricultural co-operative and represent in the class.

Exercise

Multiple Choice Questions

1. Which one is an environmentally friendly agricultural technology?

a. Use of pesticides
b. Use of chemical fertilizers
c. Following crop rotation
d. Use of chemicals for warehousing

2. To improve the quality of agricultural products-

i. Arrangement according to the quality of the crop
ii. Proper storage of the produced crop
iii.Proper care of the crop

Which 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 stimulus and answer questions 3 and 4:

The farmers of Sidla village had struggled to produce the desired crops due to a prolonged lack of irrigation. To address this issue, they established the Nab Jagran Agricultural Cooperative Society with assistance from the Agriculture Officer, Mr. Alam. By embracing sustainable and eco-friendly technology, the farmers of Sidla village are now role models for the region.

3. Through that society, the farmers of the area get ---

i. Benefits of using advanced agricultural technology
ii. Guarantee of high pro fit
iii. Benefits of using chemical fertilizers

Which of the following is correct?

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

4. Which echo-friendly method do the farmers of that village adopt to solve the problem?

a. Digging shallow tube wells
b. Digging deep tube wells
c. Construction of above-ground reservoirs
d. Irrigation system through pumps

Short-answer questions:

1. Explain the concept of agricultural cooperatives in the light of 'ten sticks are one burden/Many a little makes a mickle.'
2. Explain two steps necessary for rural farmers facing a financial crisis in agricultural work.
3. What is an agricultural input cooperative? Why is mechanization necessary in agriculture?
4. What is the minimum amount of land required to make a profitable agricultural farm? How do agricultural cooperatives overcome the scarcity of land?
5. Explain how cooperatives help in marketing agricultural products.

Creative Questions

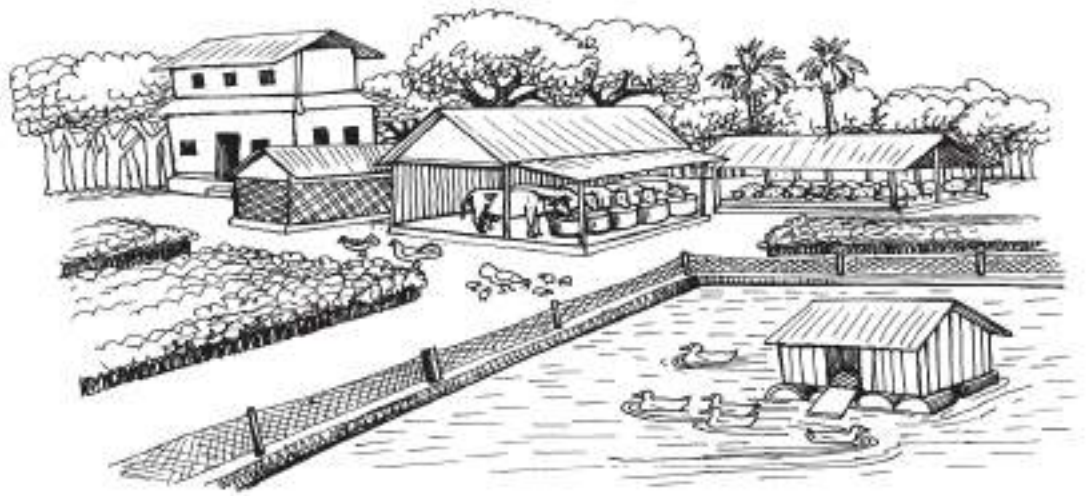
1. Md.Shamsu Uddin and Jahirul Hoque are residents of a village in the Jessore district of Manipur. Apart from their homestead, they have little cultivated land. Their neighboring farmers are in the same situation, which makes it hard for them to meet their household expenses. On the advice of a youth development worker, the farmers of the village, led by Md.Shamsu Uddin, formed a cooperative society and took the necessary steps to obtain agricultural loans. Meanwhile, under Jahirul Hoque's leadership, everyone began working on various projects by establishing a 'flower nursery' through the cooperative. In a short time, they started earning money.

a. What is an agricultural cooperative?
b. Explain how the cooperative system teaches others to be active.
c. Explain the course of action taken by Md.Shamsu Uddin.
d. Evaluate the effectiveness of Jahirul Hoque's leadership in increasing farmers' income in the region mentioned above

Chapter Seven

Household 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.



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 Household Agricultural Farm

Household based Agricultural Farm

Farmers in Bangladesh produce crop, vegetables, livestock, poultry and fish by household 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 income after meeting up the family needs. Nowadays farmers are planning to set up farms considering earning a decent income from family agricultural farm. Generally, family members maintain the family agricultural farm.

Importance of household based agricultural farm

1. It meets up the demand of food and nutrition.
2. It plays role to entertain guests.
3. It creates employment opportunity 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.

Household Vegetables and Poultry Farm

Generally, the objective of household 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 meeting up the family needs. If it is cultivated advanced crops by household intensive care, high market price may be achieved. Nowadays, any of the vegetables can be produced all the 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.

Household 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 rear chicken, duck and pigeon in household 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 income is 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 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.

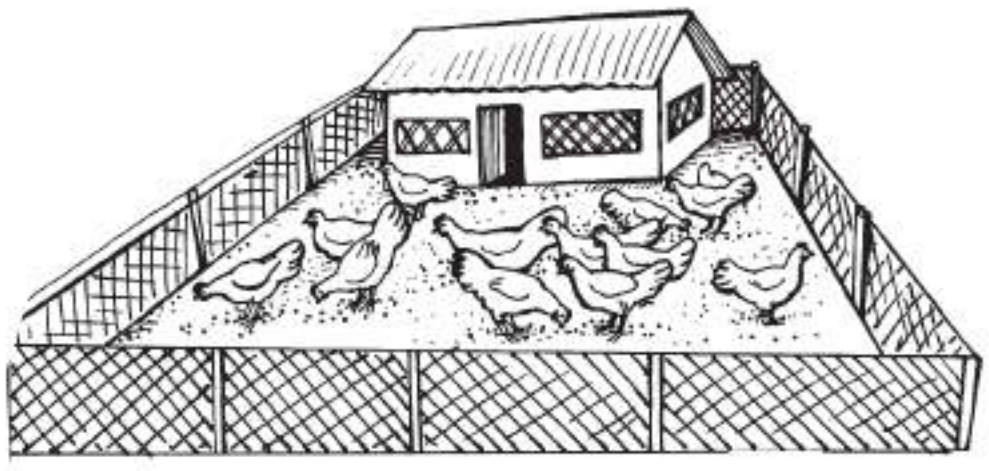


Fig: A household poultry farm

In this household farm, improved types of broiler, 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, 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 the poultry healthy 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.

- To start the farm with healthy birds.
- To set up the farm in flood free high land and to keep clean around the farmstead area.
- To spray disinfectant sometimes around the farmstead area.
- To make drain for proper drainage.
- To make fence around the farm if possible.
- To keep dry litter and floor of chicken house.
- To make house with east-west long.

- To facilitate proper ventilation.
- To keep feeder and drinker clean.
- To provide balanced ration and pure water.
- To follow separate vaccination program for broiler, layer and chicken.
- 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.

Household livestock farm

Like poultry, livestock rearing is also the feature of household agricultural farming of this country. In case of domestic livestock in our country, cattle, goat, buffalo and sheep are among them. Household 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. Household 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 goats (buck) can be marketed at their 8 months of age.

Our native cow gives 1.0-1.5 liter milk daily. So, from such a household dairy farm, our nutritional requirement can only be met up but no extra income can be earned. There is no chance for loss in household 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 daily. 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 household farm, the number of cows may be of 2 to 5. If the cows' number increases, the farm is turned to a commercial farm and manpower needs to be recruited for proper management.

To maintain a household 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 diseases break out in farm, it will take more time to

make animal productive after treatment. So, following health management practices should be followed to prevent diseases during maintaining a livestock farm.

- To set up the farm in high land and to keep clean around the farmstead area.
- To control the entry of people.
- To spray disinfectant regularly in farmyard.
- To make drain for proper drainage.
- To make cattle house with east-west long.
- To facilitate proper ventilation.
- To protect wild animals and birds.
- To keep feeder and drinker clean.
- To provide balanced diet and pure water.
- To wash animal.
- To follow separate vaccination program for cattle, buffalo, goat and sheep.
- To burry the dead animal.
- 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.

Household 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 in 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 meeting 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 considering it as family fish farm. This family

fish farm can easily be maintained by household women. If women spend some times along with their regular jobs 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 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 two years old are able to release eggs.

B. Exotic fish

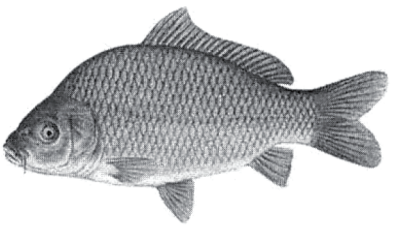
Some exotic fishes that can adapt in our environment and fries can also be easily produced in the hatchery have been brought to our country. Some remarkable fishes of this type are Silver carp, Grass carp, Carpio, Thai shwarputi, Telapia, Nilotica and Thai pungush. This type of fish can be cultivated as mixed culture with native carp.



Silver carp



Grass carp



Carpio



Nilotica



Shwarpunti

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)

Cleaning weed from pond, removing predators & unnecessary fishes, repairing bank of the pond, application of lime, application of fertilize, examining the natural feed of pond, toxicity test for water

B. Management practices during fry stocking: Selection of fry species, isolation of superior fry, fry Purifying, fixing the quantity of fry, fry transportation, fry stocking and releasing

C. Management practices after fry stocking: Regular manure application, application of supplementary feed, evaluation of fish growth and health management, 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, tourch for watching, net (lift net, cast net, seine net)

Health management for fish

Fish may be affected by diseases during cultivation. Measures should be taken instantly by observing the health condition of fish and pulling them through netting in the pond once at every month. The general symptoms of fish diseases 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 fit rot, red futki, gill rot and argulus. If diseases break out in the fish pond, advice should be taken from Fisheries Officer and management should be taken accordingly. Initially 0.5-1.0 kg lime is applied per decimal as per the condition of the pond.

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 temperatures. 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.

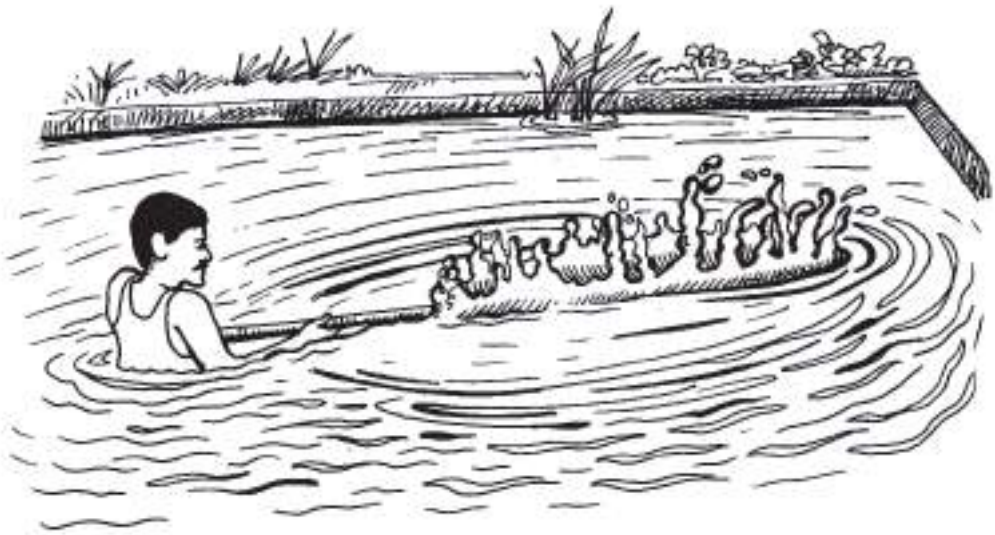


Fig: Stirring pond water by hitting bamboo

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 by thin cotton cloth. Temporarily supply of fertilizer and feed should be off. Water may be changed if it is required. It can be controlled biologically by releasing few big sized silver carps.

3. Red layer on water

This problem is seen because of 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.

Remedies: If small packets with copper sulphate making at 12-15gm 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. Algae can be removed 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 gm/decimal) can be applied in the pond.

5. Gas storing in the mud of the bottom of the pond

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 from the pond when it is dried. Gas in bottom layer will be removed by pulling horrah.



Fig: Horrah

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: Low income, Horrah

Section-2
Household 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 villages and town. 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 household 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:

- Comparatively high and dry land
- Farm land development and building.
- Scope for farm extension
- Far from homestead area.
- Good communication system.
- Availability of feed and water.
- Considering product's demand and marketing system.

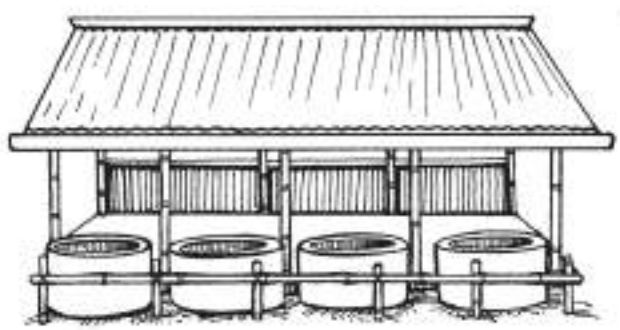


Fig : Family cattle house

Required materials for household dairy farm

Various materials are required for establishing a household dairy farm. Different materials including capital and parturition of cow, are required for building up a farm. Quality should be considered during selecting and purchasing of materials. Introduction of materials is given below:

Capital, farm land , improved cow breeds, standard farm house, building materials for farm house, improved feeder and drinker, land for grass cultivation, water line, pick up/ motor van or rickshaw for transportation, chopper for grass cutting, feed trolley and different farm equipment, utensils for milking and distribution, first aid kit for animal, sufficient green grass and concentrate feed, artificial insemination for animal

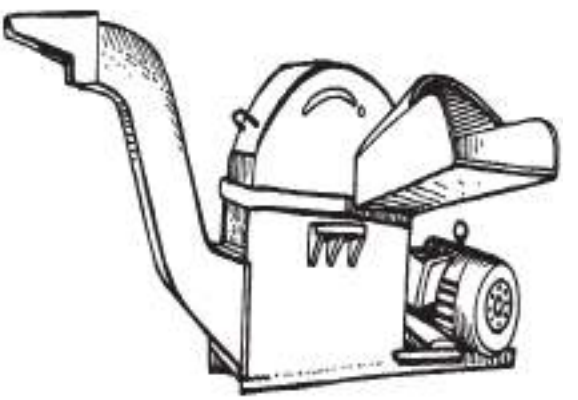


Fig: Chopper for grass cutting

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- Daily Cow

1. Milking time: Milking can be performed two or three times everyday. If it is performed by maintaining specific time, milk production might be increased.

2. Preparation of cow: Never make the cow excited or disturbed 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 should be 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 pot for milking: During milking from udder, hygiene milk-bucket with cover and handle should be used instead of simple bucket. After milking, milk-bucket is be washed with warm water initially and then with clean cool water by rubbing with brush. Milk-bucket 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 methods 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 two 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.

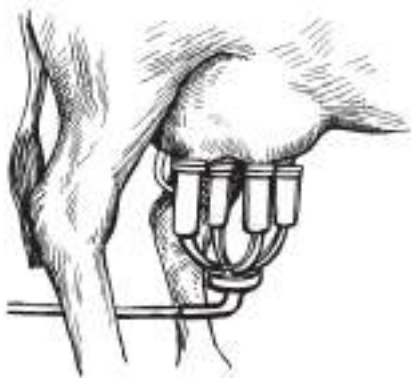


Fig: Modern Method

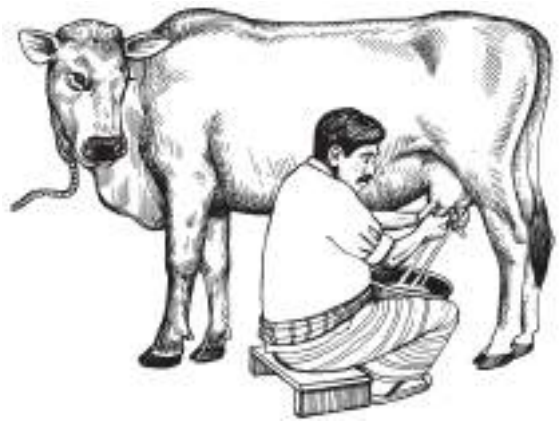


Fig: Old Method

In large commercial farm where the number of cows 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 micro-organisms in milk cause sour taste by producing lactic acid. *Streptococci,* a micro-organism, mainly produce acid in milk. In normal temperature, micro-organisms 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 milk is boiled once, it will keep milk fresh up to 4 hours. So, if milk is boiled for 20 minutes in every 4 hours, all kinds of diseases 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 4^{o}C.
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 starts 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 micro-organisms. The

micro-organisms cannot grow and multiply in high and low temperature. Using this temperature, germs causing micro-organisms could be controlled and the process is called pasteurization. The aim of milk pasteurization is to destroy germs causing micro-organisms. 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 micro-organism. 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 germs causing micro-organisms 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 germs causing micro-organisms 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.

New Word: Milking, 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 1 bigha (33 decimal)

High land	:	3 decimal
Medium low land	:	10 decimal
Pond	:	20 decimal
Farm	:	3
i. Fish farm	:	20 decimal
ii. Vegetable farm	:	10 decimal
iii. 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 with100 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, littre (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 with100 birds is given below as an example.

Chick price (Tk. 50.00/chick)	Feed purchasing (300 Kg, Tk. 33.00/Kg)	Electricity cost	Vaccines & Medicines	Littre	Lab our	Transpor tation 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, equipments, capital & recurring expenditure.

Total depreciation cost:

1. On chicken house (5% on Tk. 8000.00) = Tk. 400.00
2. On equipments 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 with100 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

Multiple Choice Questions

1. Which fish is cultivated in family mini-ponds?

a.Mrigel b. Grass Carp
c. Sarpunti d. Pangas

2. Purpose of milk pasteurization -

i.To destroy germs
ii.To maintain quality
iii.To control chemical elements

Which 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 stimulus and answer questions 3 and 4:

In the 1960s, Milon Mia cultivated fish in a pond in front of his house that was 1.5 meters deep. At the end of the rainy season, he went to the pond and noticed the fish rubbing their bodies against the bamboo planted along the ghat. When he consulted the fisheries officer about this, the officer provided him with some advice.

3. What disease did the fish in Milan Mia's pond suffer?

a. Wound disease/Ulcer b. Tail rot disease
c. Fish lice disease d. Red spot disease

4. How many kg of Dipterex is required for Milan Mia's pond at least?

a. 1.5 kg b. 1.8 kg
c. 2.5 kg d. 2.8 kg

Short-answer questions:

1. What is a dairy farm? Why does the future of this farm depend on calves?
2. Why do fish gasp in ponds? Explain one way to remedy this.
3. What are the benefits of pulling 'horra' in ponds?
4. What is milk preservation? Why does milk taste sour when kept at a normal temperature for a long time?
5. What are recurring or running costs? What is the relationship between accounting and the success of a farm?

Creative Questions

1. Arif and Asif have been raising local chickens in their yard for a long time. Since they were not making much profit from it, they trained in poultry farming and established a family poultry farm. They achieved success in a short period. However, they noticed that the waste from their farm was polluting the environment at home. In response, they took the initiative to decompose the farm waste and use it on the crop land.

   a. What is a family farm?
   b. Explain the need for a commercial farm.
   c. Explain the reason for Arif and Asif's success.
   d. Analyze the rationale for Arif and Asif's initiative.

The End

2026 Academic Year

Classes Nine and Ten : Agriculture Studies

পরিশ্রম কখনও নিষ্ফল হয় না।



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